Science Education

SOME IMPORTANT BIOLOGICAL PROBLEMS OF THE SOUTHEASTERN REGION *

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The Southeastern Region of the United States is confronted with many problems peculiar to itself. There is urgent need for a more thorough understanding of the problems on the part of the citizens of the region in order that they may cooperate in an effort to solve them. There seems to be no better way for all the citizens of the region to acquire a more adequate knowledge of the problems than through the program of the public schools. Many of the persistent problems are of a biological nature and afford worthwhile fields of study for the high school biology course.

The three-fold purpose of this study was (1) to select a few of the problems of the Southeastern Region which are of a biological nature, (2) to determine what contributions the biological sciences taught in the secondary schools of the region are making to aid in the solution of the problems, and (3) to suggest curriculum units for high school biology courses which may be of practical value to the people of the Southeastern Region.

In an effort to select some of the important biological problems of the region an analysis of certain published materials was chosen as the best means of making the selection. The selection of the printed materials to be examined was made by consulting the *Reader's Guide*, the *International Index to Periodicals*, lists secured from the United States Government printing office, and by examination of various publications secured from the state departments of each of the eleven states in the region. Current magazines, books, and state and national reports were found to be the best sources of materials.

By means of a careful examination of one hundred five magazine articles, thirty books, and numerous national publications dealing with various phases of life in the Southeastern Region, five major problems were selected. The following criteria served as a basis for the selection:

1. The problem should affect the welfare of the eleven states of the Southeastern Region as a group.
2. The problem should involve accepted regional trends which are of vital importance to the society of the region.
3. The problem should be of importance to more effective living.
4. The problem should be one revealed by authoritative sources.
5. The problem should have a high frequency of appearance in the printed materials examined.
6. The problem should be of such relation to life in the region as to be termed biological.

The five problems selected were, (1) *Soil erosion and depletion*, (2) *A need for conservation of forests and forest products*, (3) *Dietary deficiencies*, (4) *Health deficiencies not of a dietary origin*, and (5) *Inadequate living conditions*.

To determine what the biology courses offered in the region were doing to aid in the solution of the five problems selected, state courses of study were examined, questionnaires were sent to 883 (20 per cent) of the accredited public secondary schools of the region, and an analysis was made of the textbooks and workbooks used in the biology courses.

An examination of the state courses of study showed no definite course of study

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for high school biology in any of the states. In practically all instances the most recent state course of study advocated a core curriculum with a series of curriculum areas in which units might be developed which would involve biology as well as other subjects. Replies to letters sent to the high school supervisors of the region indicated that in most cases the courses of study for biology were prepared by the individual schools.

The questionnaires contained forty-eight topics related to the five biological problems selected for this study. The topics were chosen by consulting printed materials dealing with high school biology courses, and from the examination of the materials used in making the selection of the five problems. The questionnaires requested the teachers of biology to check the topics they were including in their biology courses; to give the approximate number of class periods devoted to each topic; to indicate the basal textbook and workbook used; to show the basis or bases of the pupil's learning experiences by checking the contacts made with available materials—contacts with basal text, contacts with other printed materials, contacts with laboratory materials, and contacts with community materials and conditions; to state the approximate number of pupils enrolled in the biology courses; to state whether or not biology was required for graduation, and to state in which year of the high school course biology was offered.

The questionnaires were sent to schools selected from lists of state accredited schools and lists of accredited schools prepared by the Southern Association of Colleges and Secondary Schools. Twenty per cent was arbitrarily chosen as a sampling of sufficient size to give reliable evidence of the content of the biology courses. Schools were selected from widely distributed areas in each of the eleven states, ranging in size from schools employing three teachers to those employing more than one hundred teachers. Schools of the urban, rural, and rural-urban types were selected, as well as schools for both white and negro children.

Basal textbooks were used in 92.41 per cent of the white schools and 94.75 per cent of the negro schools replying to the questionnaire. Workbooks were used in 60.07 per cent of the white schools and in 37.43 per cent of the negro schools. In many cases these books determined the content of the biology course. Therefore, in order to determine what materials the students were contacting for their learning exercises, the twelve textbooks and seventeen workbooks used in the 385 schools replying to the questionnaire were analyzed. The average number of pages of print, the average number of pages of illustrations, the average number of exercises, and the percentage of the total pages in the books devoted to each of the topics in the questionnaire seemed to be the most accurate way of judging the treatment of the topics.

Two textbooks were used in 86 per cent of the schools, 54 per cent were using Baker and Mills' *Dynamic Biology,* and 32 per cent were using Smallwood, Reveley, and Bailey's *New Biology.* Seventy-eight per cent of the workbooks used were those which accompany the two most widely used textbooks. Contacts with basal textbooks and workbooks constitute so great a percentage of the pupils' learning experiences that a separate analysis was made of the two most widely used textbooks and their accompanying workbooks.

A synthesis of the data secured from the questionnaires and the analyses of the textbooks and workbooks showed significant facts concerning the treatment of the five major biological problems.

The average number of schools offering any one of the topics included in the questionnaire in their biology courses was 317, or 82 per cent of the 385 schools.

However, the average number of class periods devoted to each topic was 2.23, and less than 2 class periods were devoted to each of twenty topics. The contacts made by the pupils in their learning experiences while studying the topics were as follows, (1) basal textbooks, 74.66 per cent, (2) other printed materials, 63.53 per cent, (3) laboratory materials, 31.45 per cent, and (4) community materials and conditions, 47.52 per cent.

The average number of schools treating topics dealing with *Soil erosion and depletion* was 242, or 62.80 per cent of the total number of schools. The average number of class periods devoted to the treatment of this problem was 1.40, and an average of only 47.43 per cent were making contacts with conditions in the community.

Topics relating to *A need for forest conservation* were treated in an average of 324, or 84.1 per cent, of the schools. The average number of class periods devoted to this problem was 2.10. The various contacts made by the pupils with sources of material were, (1) basal textbooks, 73.79 per cent, (2) other printed materials, 56.29 per cent, (3) laboratory materials, 22.95 per cent, and (4) community materials, 56.67 per cent.

Topics dealing with *Dietary deficiencies* were treated by 351, or 91.70 per cent of the schools, while the average number of class periods devoted to the development of this problem was 2.79. The contacts made were, (1) basal textbooks, 88.17 per cent, (2) other printed materials, 76.53 per cent, (3) laboratory materials, 39.47 per cent, and (4) community materials, 55.53 per cent.

Topics relating to *Health deficiencies not of a dietary origin* were treated in an average of 277, or 71.90 per cent, of the schools. The average number of class periods devoted to this problem was 2.31. The contacts made were, (1) basal text, 85.31 per cent, (2) other printed materials, 68.40 per cent, (3) laboratory materials, 28.20 per cent, and (4) community materials, 38.02 per cent.

Topics relating to *Inadequate living conditions* were treated in an average of 277, or 71.90 per cent, of the schools. The average number of class periods devoted to this problem was 1.71. The contacts were, (1) basal textbooks, 67.02 per cent, (2) other printed materials, 61.29 per cent, (3) laboratory materials, 31.62 per cent, and (4) community materials, 59.34 per cent.

All of the five major problems were treated, in some manner, in an average of 309, or 80.2 per cent, of the schools. However, the average number of class periods devoted to each of the problems was 2.06.

An analysis of the textbooks showed: (1) *Soil erosion and depletion,* treated in as many as seven books, with an average of 1.05 pages, or .0037 per cent of the average number of pages in the books; (2) *A need for forest conservation,* treated in as many as twelve books, with an average of 1.31 pages, or .0037 per cent of the average total pages in the books; (3) *Dietary deficiencies,* treated in as many as eleven books, with an average of 1.72 pages, or .0054 per cent of the average total pages; (4) *Health deficiencies not of a dietary origin,* treated in all the books, with an average of 1.46 pages, or .0054 per cent of the average total pages; (5) *Inadequate living conditions,* treated in as many as seven books, with an average of 3.33 pages, or .0098 per cent of the average total pages.

The separate analysis of the two most widely used basal textbooks showed their treatment of the five problems to be as follows: Smallwood, Reveley, and Bailey's *New Biology* devoted 1.5 pages to the treatment of *Soil erosion and depletion;* 1.80 pages to *A need for forest conservation;* 2.99 pages to *Dietary deficiencies;* 2.47 pages to *Health deficiencies not of a dietary origin;* and no provision was made

for a treatment of *Inadequate living conditions.* There was a total of 6.35 pages given to the treatment of all five problems. There were, however, 48 pages of print and 17.25 pages of illustration devoted to the systems of the human body. These exercises might have been used in the development of studies dealing with health problems.

Baker and Mills' *Dynamic Biology* devoted no exercises to a study of *Soil erosion and depletion.* There were 2.93 pages devoted to *A need for forest conservation;* 5.25 pages to *Dietary diseases;* 3.32 pages to *Health deficiencies not of a dietary origin;* and 1 page to *Inadequate living conditions.*

In the workbooks examined, an average of only 16.81 exercises were devoted to the treatment of the five problems. The average number of exercises and the average number of pages devoted to each topic were as follows: *Soil erosion and depletion,* 1 exercise and 1.16 pages; *A need for the conservation of forests and forest products,* 1.01 exercises and 16.3 pages; *Dietary deficiencies,* 1.48 exercises and 1.94 pages; *Diseases not of a dietary origin,* 1.33 exercises and 1.77 pages; and *Inadequate living conditions,* 1 exercise and 1.15 pages. There were 11 exercises and 20.98 pages devoted to a treatment of the systems of the human body which might have been used in treating some of the health problems of the region.

The analysis of the two most widely used workbooks also indicated inadequate treatment of the five problems. Baker and Mills' *Activities for Dynamic Biology* treated only three of the problems. This book gave 2 exercises and 2.70 pages of print to the treatment of *A need for conservation of forests and forest products;* 1 exercise and 2 pages to *Dietary deficiencies;* and 11 exercises and 19.25 pages to *Health deficiencies not of a dietary origin.* Eight exercises and 24.5 pages were devoted to a study of the human body.

Bailey and Greene's *New Laboratory Manual* treated only two of the problems. This book devoted 1 exercise and 2 pages to *Dietary deficiencies* and 2 exercises and 8 pages to *Health deficiencies not of a dietary origin.* Fourteen exercises and 17.75 pages were devoted to a study of the human body.

The data secured by analyses of replies to questionnaires, textbooks, and workbooks point definitely to the conclusions that the biological sciences of the secondary schools of the Southeastern Region are actually doing little to solve some of the persistent biological problems of the region.

Biology teachers are devoting very little time to the development of practical units in their high school biology courses. They are making little use of community conditions and materials which might be of significance in helping the pupils to gain a better understanding of many of the problems which affect their lives. The teachers are using a limited amount of laboratory and printed materials. Many of the courses are based entirely upon the content of two textbooks and their accompanying workbooks. The textbooks and workbooks used provide very little material which will lend itself to the development of significant units in high school biology courses. The schools are, for the most part, offering the traditional textbook type of biology course in which a large number of topics are treated in daily lessons.

The dependence upon a single textbook for a treatment of biological materials, and the failure of the textbooks to treat adequately these materials, is the possible explanation for the failure of the biology teachers to organize their courses into units of study which contribute to important curriculum areas suggested in their state courses of study.

In order to suggest a way whereby the various phases of the important biological problems of the Southeastern Region may be used by teachers and curriculum work-

ers, a suggested outline was proposed for a course of study unit in the curriculum area, *Conservation of Natural Resources.* An additional list of topics was prepared which might be used by teachers of biology in developing units of study pertinent to the needs of the children enrolled in the secondary schools of the region.

PUPIL-TEACHER PLANNING IN JUNIOR HIGH SCIENCE CLASSES

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Changes in methods of procedure in education have been making rapid progress during the past few years. One of these changes has been a shift from the old stereotyped method of imparting knowledge by the teacher to the student to the pupil-teacher planning methods. This article is an attempt to explain how a unit of study in seventh and eighth grade general science is followed through at Roosevelt High School.

We refer to each body of subject matter as a unit of work, and it is our aim to study each unit as a single piece of work and yet to be sure that it is studied in relationship to all other subject matter in the same field. We can isolate in words and form only, for there are always parts of science that overlap.

The pupil-teacher planning method is a learning situation where the efforts and thinking of both the teacher and the student are utilized. This makes for a flexible program that is most desirable in teaching the development of a scientific principle. The instructor will find in pursuing this method, that the learning process is not confined to the student, but that he too is constantly discovering the aptitudes and interests of his students. The especial benefit to the student himself is the constant encouragement and necessity for independent thinking and action.

At first sight this method appears deceptively simple. The novice instructor might say to his class, "Here is a unit. What do you want to study about it?" but he is forgetting that he is dealing with pupils who are meeting strange and unfamiliar situations, and who are apt to be bewildered at such an abrupt approach. He will find, perhaps, that a lecture on the unit to be studied, covering the subject matter in a general fashion, will be a more gradual and comprehensive approach. The unit itself should be justified as a part of the student's environment and experience, and also should be considered in the light of its value to the student. The class should be informed in this first lecture what the aims of accomplishment for the unit will be. Needless to say, the instructor himself must have these aims very firmly fixed in his own mind at the outset of the project, and should keep them clearly before him throughout the entire period of study. Thus he will also always keep in mind the all-important fact that he is working with students as well as with subject matter.

Through a process of experiment and elimination we have found that the following aims are of first importance and should be followed during the unit study. First, always teach in such a manner that students become interested and skillful in recognizing scientific problems. Second, teach so that pupils may learn to collect and satisfactorily organize the important evidence in a scientific problem, and after that teach so that a student may draw reasonable conclusions from that evidence.

Above all, teach so that pupils may be open-minded and willing to work for understanding and proof of all facts or experiments that are new to him. Finally, teach so that the student's general work habits and attitudes are constantly being improved.

After the introductory lecture, it is well to have the student do some preliminary reading on the unit selected. This reading will be important in several different ways. First, the student will acquaint himself with the possibilities of the topic as a complete unit. He will be able to compare some of the things he reads and the illustrations he sees with related knowledge within his own scope of experience. He will be led from this comparison to a judgment of the value of the unit to be studied to himself, individually. Throughout all this, he is unconsciously for the most part gaining a desirable way of expressing himself which will be of great benefit to himself and to the rest of the class later on. This preliminary reading should be extensive enough to make the student well enough acquainted with the subject that he may express his own views and knowledge in an intelligent manner.

Following this period of reading, the next and very important step is to construct a pattern to work from. Here the instructor plays a most important part as leader and guide. Our pattern takes form as an outline, to which each student contributes. This is his opportunity to express his own thinking, and to present his findings from his own reading and experience. The instructor at this time should be careful to see that he does not discourage a student who is eager to contribute, although his contribution is of little or no importance. The fact that he has tried to contribute is of great importance, and with judicious and tactful explanation he may be set on the right track.

At the beginning of this third step the instructor might ask his class a few well-directed questions such as, "What are the things you think we should study about this unit?" or, "What things are you so interested in that you want to study them?" or, "What things are so valuable that you feel we must not miss them?" If the first two steps as described above have been adequately taken care of, the response at this time will be surprising.

The instructor of a pupil will then proceed to write on the blackboard the answers given to the above questions, or any other questions that may be substituted for or added to them. All the statements and questions should be set down except any that are duplicates. The judging of which are duplicates or must be set up as independent parts of the outline in itself leads to interesting discussion.

Since at this time the important thing is to present the thinking of the individual students it will be found that the ideas presented will not be in any form or order. This will be especially true where there has been much preparatory reading on the subject. We, however, write them down exactly as they occur and arrange them logically and in sequence later on (this is a further step in the teacher-planning method).

The outline work will serve not only to encourage the individual student to contribute, but is also a splendid opportunity for the class as a whole to work together and also to work with the instructor. As a finished piece of work it should be a sum total of all that has been contributed both by the instructor and the class. If the instructor feels that some important phase of the unit has been overlooked, he should include it also, making clear to the class first his reason for so doing.

As the outline takes form in sequence of subject matter the more important remarks or questions should be marked in some way, perhaps with an asterisk or in a different color of chalk, so that they stand out. The class now should copy

down these specially marked parts, leaving room under each for the remaining topics which will be sub-headed. As each sub-topic is added, it, too, should be marked so that it will not appear twice.

There are two important aims to keep in mind while the outline is being formed: first, that building on the main subjects should always be done from the matter furnished by the students in the sub-topics; and second, that wherever something is missing of importance among the major headings the instructor sees to it that it is included.

Once the outline is finished the scientific principle which is in any way evident must be deduced from the findings of both instructor and pupil. Then the instructor must see that the student is given every opportunity for as many contacts with this principle as is possible. These contacts may take the form of experiments or demonstrations. When that is the case, careful record should be kept by each pupil of the experiment itself and the findings thereof, in his own words. This record should be simple but inclusive.

Illustrations of various kinds are interesting to the student and may be included in his notebook. These may be copied from books, cut from magazines, or drawn neatly freehand.

Every opportunity for local study in connection with the unit should be taken. This may include trips to various places or institutions close by; study of newspaper articles; contact with the weather bureau, water works and other municipal and government projects; and a survey of the various pamphlets furnished by the state and federal governments. These latter will be especially helpful in units dealing with conservation or the different phases of agriculture.

From the outline the individual student is now ready to draw up his own piece of work. While he is doing this he should have easy and unhampered access to reference books. Too many restrictions or too much red tape will not help him to become acquainted with the use of a reference library.

It will be noted that the individual's approach to the unit will vary. One will read constantly for several days before he does much work on paper, while others will methodically set down their findings on each topic and sub-topic or arrange a summary to be used later in preparing answers to the various questions that have been included in the outline. Those students with an ability to draw will illustrate the outline, and many will make the local contacts spoken of before. Much of this type of work will include observations made very close to home, in the student's yard, garden, or perhaps his father's automobile or through the plumbing or heating systems of his home.

It will probably be found that all the students will not finish at the same time, nor will all accomplish the same amount of work or be as thorough in isolating each scientific principle, but usually each will work to his own individual capacity. If a quick student doesn't find additional work for himself after his required task is completed, the instructor may suggest other lines of thought to follow up or may allow him to assist a slower fellow pupil. All this, of course, does not make for a quiet class room at times but bears out the workshop aims of the unit study.

When the entire class has finished their outlines, the papers are handed in to the instructor, who marks mistakes but does not furnish the correct answers. The papers are then returned to their owners. The instructor may use several different methods for correcting the errors. If he feels that he cannot allow a great deal more time on the unit, he himself may point out the greater portion of error. This can be accomplished for the most part in two or three class sessions. Discussion between members of the class and

between students and instructor are very helpful, for it is here that the individual thinking will be exercised. The instructor should take care that this does not turn into a routine question-and-answer game with the teacher asking the same question of one student after another until someone is fortunate enough to know (or to guess) the right answer. This discussion period should be one of true constructive value with each member of the class being given an opportunity to present to the class and to the teacher his own findings and his own questions. The instructor will frequently find himself learning through this discussion also!

Where the instructor feels that there is ample time, he may allow the students to restudy their outlines, giving especial thought to those problems in which mistakes or questions appeared. Then a second discussion period will be held.

Our students at Roosevelt have been very interested in recognizing and learning to use and to spell scientific terms which appear in each unit. When the outlines are handed in each misspelled work is marked with a colored pencil. After receiving his outline again the student copies all words or terms so marked, and hands the list to the instructor, who then compiles a complete list from all the papers. This compilation is then given to every member of the class, who must learn to spell and recognize all the words on the list. It is only fair to mention that we have met with considerable success in spelling, and the students are learning to use the words correctly which will be of great benefit to them in more advanced study and reading.

The final step in this teacher-pupil planning method comes when the instructor determines what advancement the class has made as a whole, and (what is more important) the individual advancement of each individual. The class should be asked to report on what it has learned, and this report may take form in a statement, which like the beginning of the study, is placed on the blackboard. As student after student contributes to this list, the great variety of thought will be noted. Heading this list are the statements concerning the scientific principle itself, and the general statements follow.

Finally, with the completed list of findings before him, the instructor must ask himself if the aims he had in view at the outset of the unit study have been accomplished. He must determine whether the study has been valuable to the student; whether the experiments and demonstrations have been interesting and helpful. He must be very sure in his own mind that the finished project has been the work of the entire group and not that of a few of the more brilliant students, and also that he has been tolerant and receptive to every idea presented. He must be satisfied that the outline was made clear to everyone, and that sufficient time was allowed throughout for a thorough appreciation of the unit.

The method of individual testing has not advanced in recent years. To continue to use the question-answer method in this field may require a store of information on the part of the student, but it does not necessarily mean that either he or the instructor must do a great deal of thinking. In our method it is required that every student and their instructor think to the best of his capacity.

THE SUN: A UNIT FOR THE FIRST GRADE

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Experience has taught us that little children are very inquisitive and curious. It has also taught us that they are many times oblivious to big and important factors necessary to their daily existence. There is no denying that when once aroused their interest and enthusiasm may carry them far beyond the expected avenues the teacher had anticipated and challenge even the most skillful of teachers.

The following activities were engaged in by a group of beginning first grade children who comprised the demonstration first grade at the Homewood Demonstration School, which is conducted each summer at the Johns Hopkins University through the cooperation of the Department of Education of Baltimore and the University. The record of these activities may serve to give meaning to the introductory paragraph.

The class was fortunate in having a large playground with many trees for shade and large open spaces when more desirable. The bright sunny day when the unit got its official start, the children played Shadow Tag in the open spaces. In this game a child must be "It" and remain "It" until successful in jumping on a playmate's shadow. If he is successful in jumping on a shadow, the child whose shadow is "caught" must be "It." Thus the game proceeds with the teacher or another child deciding who has been caught.

After playing for several minutes, the group retired to the shade of the trees to rest and cool off. Perspiration was plainly evident on the brows of many of the children and there were several comments made to one another concerning this condition, such as: (a) "It was hot in the Sun." (b) "Look how wet your face is; you were running too much." (c) "It's cool under this tree. I feel a breeze."

With this background of experience, simple though it was, the children returned to their room to begin, unknown to them but carefully planned by the teacher, an introductory science lesson, on the Sun.

The scientific principle which was to be developed in the lesson was:

The Sun as a body in our universe affects life on our planet. The knowledges to be developed within this principle are:

a. The Sun gives us light.
b. The Sun gives us heat; we could not live without it.
c. The Sun gives us more heat in summer than at other times of the year.
d. Plants need the Sun in order to grow.
e. The shadows increase and decrease in length according to the position of the Sun and time of day.
f. The Sun gives us colors.
g. Red and black are the most desirable colors for winter because of their ability to absorb the Sun's rays while green and white are the best for summer because of their ability to refract the rays.
h. The Sun aids in telling directions and as a crude instrument for telling time.

None of the aforesaid knowledges were forced upon the children and not all of them were fully accepted by some of the children because of their limited understanding. They were all developed through discussions, experiments, stories, and activities, engaged in by all the children with wholehearted enthusiasm. The children often challenged a fact that most of the group had accepted and time was taken to go back and elucidate the point again.

The activities used to establish each of the knowledges are stated below.

Knowledge: *The Sun gives us light.*

Activity:

Interest was aroused in the earth by the placement of a globe in the room. Through contributions of teacher and children the pupils learned that the earth was round, was very big, made up of land and water,

and was constantly turning around. The globe and children were then taken to a room lighted by electricity but no daylight. The question was asked: "What would the earth be like if there were no Sun?" The answer came, "dark," and the lights were put off. Then by using a flashlight and the globe, it was shown to the children how the Sun gives us light and causes night and day.

Knowledge: *The Sun gives us heat.*

Activities:

1. Games. One half of the children sat under the trees and played quiet games while the other half played skip tag in the Sun. Through discussions, the children deduced that while running had helped to make them warm the heat of the Sun had caused most of the difference between the two groups of children in regard to their appearance and feelings.
2. Experiment: "Burning Paper with a a Magnifying Glass." The children were supplied with a magnifying glass and newspaper. They were shown how to focus the Sun's rays on the paper and to watch what would happen. When the paper began to burn, excitement ran high and there were many questions. Finally the children deduced that the heat of the Sun's rays focused through the magnifying glass had caused the paper to burn, proving that the Sun gives gives heat.
3. One child had worn a play suit with cross straps and was sunburned rather badly leaving white stripes on her back where the straps had been. The reasons for this condition were discussed and a conclusion drawn.
4. Finally the question was asked by the teacher: "What would it be like if it were not for the Sun?" The answer given was, "Dark and cold." The teacher added, "Yes, so cold that it would not be possible for people to live on the earth."

Knowledge: *The Sun gives us more heat in the summer than at other times of the year.*

Activities:

1. Since this unit was carried on during summer school, the fact that the Sun is warmer in summer was very readily established. Attention to the type of clothing worn during the summer season compared with other seasons helped to establish the fact.
2. Experiment. The globe and flashlight were again employed in a dark room to show how during the winter season the Sun's rays are slanted and cover a larger area of the earth, thus spreading its warmth, while during the summer the rays shine directly down on us causing more heat. A picture was drawn by a child to illustrate this using a piece of circular black paper, chalk, and the flashlight. The flashlight rays were thrown on the paper to represent the Sun's rays in the summer shining directly on us. Then the light was slanted and the rays fell as shown on the larger area covered in winter. Figure 1.

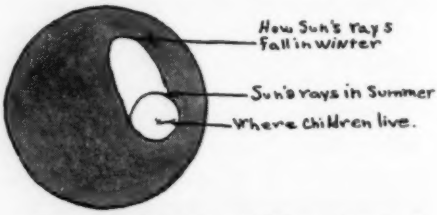

FIGURE 1.—Summer and Winter Areas of Beam of Light.

Note: The children were constantly made to realize that the Sun and earth were very, very, very large and that these experiments only helped us to understand what happened.

Knowledge: *Plants need the Sun in order to grow.*

1. Two onions were planted. One plant was placed in the Sun and one in a dark cupboard. The same was done with lima beans on blotters and flower seeds in small pots. All plants were given the same attention as to watering and conditions and comparisons were made at the end of two weeks. The children realized that water and air played an important part but that the Sun was the vital factor.
2. Also on the window sill was a green leafy plant with all its leaves turned toward the Sun. The children noted this condition and turned the plant around. They noticed as days went by the gradual change in the plant as its leaves again turned toward the Sun.

Knowledge: *The shadows increase and decrease in length according to the position of the Sun and time of day.*

1. Interest in shadows had already been aroused by the game, "Shadow Tag." One little boy was in the habit of arriving at eight in the morning so it was arranged between the teacher and child to take his shadow picture on a large

sheet of brown paper and not tell the other children. This was done and shown to the rest of the class about 10:50 A.M. They guessed what this peculiar looking picture might be. One child finally said, "It looks like a boy." Larry then told how his picture was taken. It was decided to take it again and see if there was any difference. Another child said, "You had better take a larger piece of paper." This was done and the class went out of doors, but, of course, Larry's shadow was much, much smaller quite to the delight and amazement of the children. Reasons for this were discussed and relative positions of the Sun at 8 and 11 A.M. were noted. Many children wished to have their pictures taken and some tried at at home. This brought out the fact that the shadow was cast on the opposite side of the paper in the afternoon.

2. Shadows again came into play when the class was going to have a lesson out under the trees. The chairs were fixed and then the children went to recess before having their lesson. When they came back, half of the children's chairs were in the Sun and they had to get fixed all over again. The group was readily able to state the cause of the change in the trees' shadow.

Knowledge: *The sunlight gives us colors.*
Activities:

1. Blowing bubbles. A bubble set was used that blew very large bubbles and the size of them at first was the only thing that interested the children but soon one child said, "Look at the colors in the bubble." Then all of them began to watch for the colors. Some children thought that the colors came from the soap, others were not sure, so it was decided to wait until they looked at something else the teacher had at hand.
2. Looking through prisms. The teacher handed out three prisms and told the children to take turns looking through them. Excitement reigned supreme as the colors began to fall on children's faces, legs, trees and windows. After the excitement had subsided, cooperatively, the different colors were named. Then a child made a valuable remark, "It looked like the rainbow." This remark led to the fact that the colors were in the Sun's rays and the prisms, because of their shape, separated the colors. This same fact was true when a rainbow was visible, and that the raindrops acted like the prisms. They then returned to the bubbles and asserted that the colors seen had really come from the Sun's rays.

Knowledge: *Red and black are the two best colors for winter, while green and white are the two best colors for summer.*

1. This knowledge due to the time of the year had to be established through pictures, discussions, and facts given by the teacher.
   Pictures of winter activities were shown containing children dressed principally in red and black clothes. These pictures were contrasted with the clothing the children were wearing and the predominance of white and green. During the discussion the teacher explained that green and white are best for summer because they try to push away the Sun's rays and thus keep us cooler, while black and red try to pull in the Sun's rays and thus make us warmer.
2. Imaginary experiment (could be performed in winter). Two patches of "snow" were covered; one with a piece of black cloth and one with a piece of white cloth. The children were asked to express their opinions in the light of the previous discussion as to which patch of snow would melt first. The test of their understanding came when almost all of the children realized that the snow under the black cloth would melt first because of its power to absorb the Sun's rays.

Knowledge: *The sun helps us in telling directions and as a crude instrument for telling time.*

1. Discussion: Included information given by the children as to directions where the Sun rose and set, therefore they could tell easterly and westerly directions.
2. Story: "What the Sun Told" from *Science Stories*, Book I, by Beauchamp, Crampton, and Gray.
   a. Brought out further discussion and understanding of directions.
   b. Gave a good idea of the Sun's use in telling time.
      (1) Fact was stated by a child that long ago people didn't have clocks but depended on the Sun for telling time.

The values of this unit in the light of pupil growth appear to be:

a. Initiation of some important understandings concerning the Sun as a factor in our universe.

b. Learning the value of cooperative sharing of information and discussion of same.
c. Understanding the value of experiments before stating facts.
d. Promoting real thinking before speaking.
e. Producing some "miniature scientists," whose keen interest in the things about them has been sufficiently aroused so that they will ask and will not need to be led.
f. Providing increased vocabulary and working toward clarity of expression.
g. Promoting an excellent adult-child and teacher-pupil relationship.

Even if the children should forget temporarily some of the many facts that they learned, it appeared that their lives had been enriched socially, educationally, emotionally, and mentally. Just how far-reaching the effects of this unit will be, no one will ever know.

A STUDY OF PERMANENCE IN LEARNING SELECTED MATERIALS FROM THE FIELD OF GENETICS

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In a recent report one of the authors [1] shows that certain college students who were taught an experimental unit of science, prepared with objectives consistent with objectives of general education, surpassed similar students who were taught a unit prepared as a logical organization of subject matter. The significant differences, all of which favored the experimental group of students, held for certain ranges on intelligence and initial status on the tests used in the evaluation. Both of these evaluative criteria were used as background traits for matching and their effects on the final measurements were statistically controlled.

The purpose of the study, reported in this article, was to determine if differences detected between the two groups, reported in the earlier study, tend to become permanent.

To secure a measurement of this tendency all available students were given a test one year after the completion of the original study. Of the original population of one hundred ninety-four students, one hundred twenty were available for the retest. Fifty-six of them had been members of the experimental group and sixty-four had been members of the control group.

The test used in retesting contained three sections. One of the sections was a true-false test dealing with facts from the science of genetics. Another section required that the students apply certain principles of genetics in solving specific problems. The third section asked the students to evaluate the evidence supporting each of a series of statements, "now or formerly believed as true by many people." Such evidence might be, (1) Tradition, (2) The result of observation, or (3) The result of experimentation. In computing the total scores

[1] Bond, A. D. *An Experiment in the Teaching of Genetics, with Special Reference to Objectives of General Education.* New York, Bureau of Publications, Teachers College, Columbia University. 1940. 99 pp.

See also Bond, A. D. "An Experiment in the Teaching of Genetics, with Special Reference to Objectives of General Education." *Science Education,* Vol. 24, No. 2, pp. 67–72, February, 1940.

of the students, the scores of the three sections were converted into standard deviation scores before adding. This has the effect of equalizing the weighting of each section. The three sections were weighted equally because of the absence of data indicating which type of response is of greater importance in evaluating the results of instruction.

As was stated in the opening sentences, the background traits selected for matching are intelligence and final standing on the battery of tests used at the end of the original experiment. Thus any differences detected between the two groups of students can be interpreted as having occurred during the year which elapsed between the end of the original experiment and the administering of the tests described above.

Table I summarizes the data from which the analysis was computed. The statistical technique used in analyzing this data is that described by Johnson and Neyman.[2] By means of this technique the effects of the background traits are predicted through the use of multiple regression equations. Thus the need of individually matched pairs of students disappears. In the analysis, com-

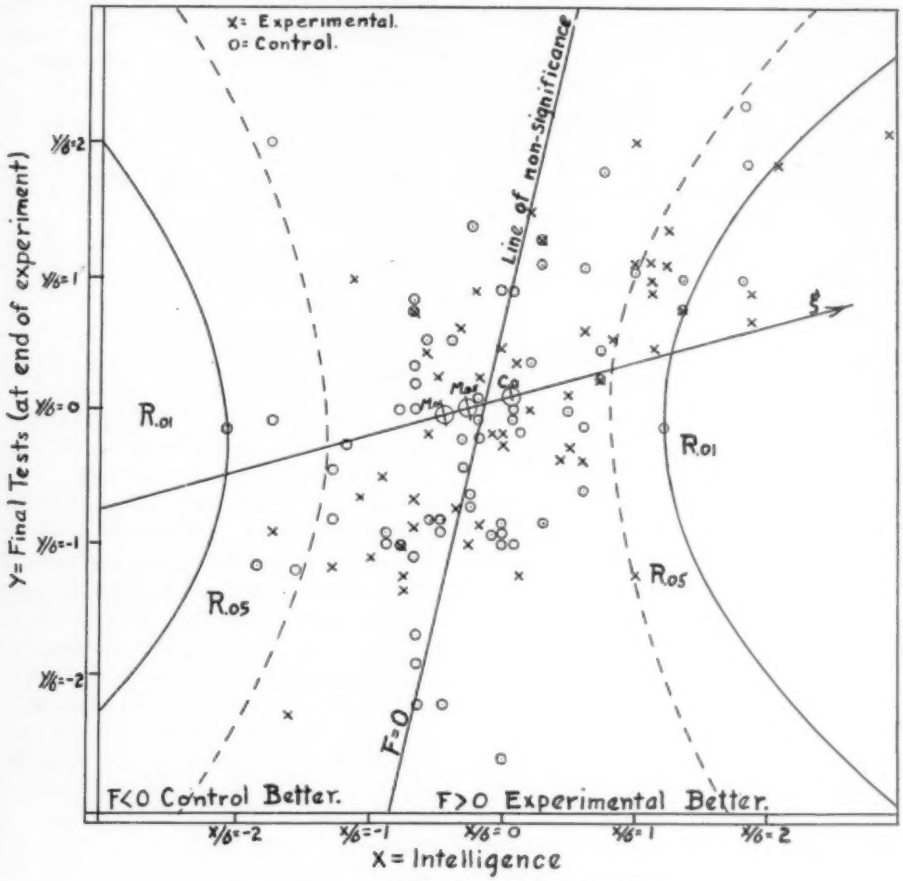

FIGURE 1.——Locations of Regions of Significance.

[2] Johnson, P. O., and Neyman, J. "Tests of Certain Linear Hypotheses and Their Application to Some Educational Problems." *Statistical Research Memoirs* 1:72–93; June, 1936.

TABLE I

SUMMARY OF DATA

Experimental Group	Control Group
$\bar{x} = 31.9$	$\bar{x} = 28.2$
$\bar{y} = 31.4$	$\bar{y} = 28.9$
$\bar{z} = 30.6$	$\bar{u} = 29.1$
$\sigma x = 8.9$	$\sigma x = 7.9$
$\sigma y = 9.7$	$\sigma y = 10.1$
$\sigma z = 7.7$	$\sigma u = 6.3$
$r_{xy} = .780$	$r_{xy} = .445$
$r_{xz} = .613$	$r_{xu} = .018$
$r_{yz} = .429$	$r_{yu} = .093$

Where, x refers to intelligence, y to final scores on the battery of tests used at the end of the original experiment, z to the scores on the test given one year later to the experimental group, and u to the scores made by students of the control group.

parisons are made between the differences (F), which are detected between the experimental and control groups of students, and the total variance exhibited by both groups. The differences and variance refer, of course, to the scores of the test administered one year after the conclusion of the original experiment. The range on the background traits wherein such differences are significant can be determined from the equations and that range can then be plotted. This range is known as the region of significance (R).

Figure 1 shows the locations of the regions of significance with respect to the background traits of intelligence and final status at the conclusion of the original experiment. Along the line of non-significance (F=O) no difference is evident between the two groups. To the right of that line the differences favor the experimental group, to the left they favor the control group. Within the regions of significance, $R_{.05}$, these differences are significant to the probability level of P=.05. Similarly the differences within the regions of significance, $R_{.01}$, are significant to the probability level of P=.01. This means that such differences would be expected to occur by chance in less than one such experiment out of twenty or in one out of one hundred respectively.

An examination of these findings indicates that:

1. After one year has elapsed the brighter students of the experimental group surpass, even more, similar bright students from the control group.
2. The less intelligent students from the control group surpass, after one year has elapsed, similar students from the experimental group.

As was pointed out in the introductory paragraph, the experimental unit was planned with objectives consistent with those of general education. The unit dealt with the biological backgrounds of racial difference and similarity. The control unit was concerned with the learning of facts from the science of genetics. In the original study the results suggested that the brighter students of the experimental group profited more by the instruction than similar bright students from the control group. This tendency is evident one year after the completion of the instruction. The tendency for the students of relatively low intelligence from the control group to surpass similar students from the experimental group is a new tendency, not detected in the original experiment.

THE FABULOUS QUEST: A STUDENT-WRITTEN SCIENCE PLAY

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and
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The play which constitutes the main part of this article, came into existence as a rather natural, although not inevitable or required, result of the activities in a unit in physical science as taught at the Lincoln School in the fall of 1939. A brief explanation of the background out of which the play grew may be in order.

The unit in question is one which utilizes some of the traditional material on the nature of chemical change and of combustion in connection with considerable historical material to show how man is continually improving and refining his notions of the world about him. The writer has often characterized the unit as one which traces the history of scientific thinking in this area.[1]

The development of our notion of the nature of matter and chemical change was seen to be an integral part of this unit. Aristotle rationalized the notion of four elements—fire, air, earth and water—through arm-chair logic which saw in properties of heat and cold, wetness and dryness, a basis for all matter. Al Geber added to the idea of the four elements, a curious notion whereby sulfur and mercury could produce all substances known to man. In so doing, all unwittingly, he gave a logical basis for the activities of the alchemists. All ordinary substances could be obtained from sulfur and mercury—why not gold, also? The work of the alchemists also exemplified a curious tendency which has persisted to the present—that of attempting to explain phenomena through postulating the existence of an imponderable, an invisible, unweighable, unknowable substance, which will have all the properties that we wish it to have—the alchemist's Elixir of Life, or, more recently, the ether, or the biologist's vital fluid.[2] The students also saw in the work of the alchemists an activity which, however erroneously directed, nevertheless kept alive an interest in experimentation throughout the medieval period. Following the abandonment of the futile search for gold, came two other fallacies—the phlogiston and caloric theories. Both of these were seen to be improvements over the theories which they replaced. The phlogiston theory was seen to require no more unjustifiable assumptions than those involved in the notion of the ether, or the Bohr atom. Illustrative of the point-of-view is the following paragraph which served as an introduction to a work-and-experiment-sheet:

> The year is about 1650. You are John Joachim Becher, adventurer son of a Lutheran minister who combined in one person at once the disinterested zeal of the true scientist and the chicanery of the charlatan. You are trying to explain the process of burning that has troubled the alchemists for many years. Being

[1] The unit is described in greater detail in the following: Brown, H. Emmett. *The Development of a Course in the Physical Sciences for the Lincoln School.* Bureau of Publications, Teachers College, Columbia University, New York, 1939, p. 81–150.

[2] An interesting discussion of this tendency is found in the following: Heyl, Paul R. "The Lingering Dryad." *Smithsonian Institution, Annual Report for 1929.* U. S. Government Printing Office, Washington, D. C., 1930. p. 205–214.

> an alchemist, yourself, you are familiar with the ancient notion of fire as one of the elements. You also know of Paracelsus' explanation of the burning of wood, *i.e.*, it burns because it contains sulfur, it gives off flame because it has mercury in it, and it leaves an ash because of the salt present in all wood. Dissatisfied with this explanation you are about to do some experiments of your own.

Finally, the overthrow of the phlogiston theory was completed by Lavoisier. His work was seen to offer rather perfect examples of the scientific method of problem solving, the steps in which were here made objective.

The play came into being in this wise. Reading, discussion, and experiments designed to show the superficial character of many of the results with which alchemists were satisfied, were used to make clear the nature of the achemist's contribution. The suggestion was made that a play, based on the life of an alchemist, written and produced by the class might help them really to savor the spirit of the period in question. This was in no sense an assignment. However, three different individuals or groups made a start. Interest in the venture was, no doubt, intensified by the attendance of a number of this group on a production of Ben Jonson's "The Alchemist." The "Fabulous Quest" was the one of the three plays which, in its rough draft, was judged by the class to seem to offer the greatest promise. The plot of this play is in no sense heavily derivative from Jonson's effort since, in contrast to Jonson's protagonist, the alchemist of the "Quest" is represented as a sincere, although mistaken individual, who genuinely believed in the possibility of his own success. On several occasions, during the writing of the play, portions of it were read to the class for criticism and suggestions. This, together with some slight help from the writer and one other teacher, constituted the only help received by the student authors.

For the writing of the play, as well as for the making of the set and costumes, and for some rehearsals, class time had to be given, of course.

A few words may be in order concerning the set. An examination of the play, itself, will reveal that a full stage setting is needed for only scenes 2 and 4, the alchemist's shop. The other scenes can be played, if desired, before the curtain. Upon the alchemist's shop as much labor may be spent as seems desirable. A furnace of the type seen in the Tenier drawings is a desirable part of this set. An incandescent lamp, placed below pieces of colored glass can be used to create the illusion of a fire. Flasks, retorts, and other pieces of laboratory glassware make valuable props. The skull of the head of a horse or cow makes another piece of atmospheric material often found in alchemical laboratories. A Bunsen burner, or alcohol burner is needed in some of the experiments. This should be disguised by building out of heavy sheet asbestos a frustrum of a square pyramid around the burner and painting it black. A fairly large table is needed, the top of which should be covered with a thick sheet of asbestos cut to fit. The legs of the table may be encased at three sides with beaver board, painted black. Dark draperies will serve as walls, although it may be desired to make a set from large flats, painted a dark color. If this is done, a door should be built into the set at one side of the stage. An effective, though anachronistic, prop used in this production consisted of two large glass cylinders, each filled with colored water and placed over lights concealed in a box. At the beginning of each of the alchemical scenes, pieces of dry ice were placed in each cylinder. Light shining up through a hole in the box and through the base of the cylinder, served to bring out the bubbling action and the "smoke" produced thereby.

In this production a small, separate set was built for scenes 1, 3, and 5. This was erected in front of the alchemist's shop for these scenes, being changed slightly to represent the room in Sir Robert's castle

of scene 1, or the room in the inn for scenes 3 and 5.

THE EXPERIMENTS

(Numbers refer to citations in the play, itself.)

Experiment 1. Experiments here are atmospheric in character. Color changes, *e.g.*, turning water with a little phenolphthalein solution in it into a red solution by adding a little alkali, or precipitations, *e.g.*, cadmium sulfide from a solution of a soluble cadmium salt by adding hydrogen sulfide water, are good experiments. Large flasks or beakers should be used. Explosions, or flame experiments should be avoided, as they are used later.

Experiment 2. Chemiluminescence. Two batches of material are prepared as follows:

(1) Make a paste of about 10 c.c. of sodium silicate and 2 grams of luminol (3-aminophthalhydrazide). Make sure that the luminol is evenly stirred into the silicate. Add enough silicate to make 100 c.c.

(2) Dissolve about 2 to 5 grams of potassium ferricyanide in 100 c.c. of hydrogen peroxide.

Pour these two solutions into a flask containing several liters (2 or 3) of water. Stir. If a really brilliant glow does not take place, a little sodium hydroxide solution may be added. The glow should persist for a length of time ample for the alchemist to say his concluding lines in scene 2.

Experiment 3. Glycerine is poured over a heaped-up cone of potassium permanganate on a piece of asbestos. A little additional potassium permanganate is sprinkled on top after the addition of the glycerine.

It will be necessary to experiment with the fineness of the grinding to which the potassium permanganate should be subjected before the experiment. A short time must elapse to allow William to perform experiment 4 and say a few lines.

Experiment 4. Warm, dilute solutions of hydrochloric acid and ammonium hydroxide may be poured together. An alternative is to pour from a bottle a little smoke-screen chemical (titanium tetrachloride). The use of this latter will necessitate a slight change in William's lines.

Experiment 5. The solution used is a mixture of about equal amounts grain alcohol and carbon tetrachloride (CCl_4) using as much of the latter as possible. Rehearsal will be necessary to perfect the technique involved in this experiment. It may help somewhat to dip the hands in a saturated solution of borax and to allow the solution to dry on the hands. This will help the performer to withstand the heat for a longer period. The flame should be extinguished, of course, before any burning of the skin takes place.

Experiment 6. In this series of experiments, powdered iron, powdered aluminum, and, finally, powdered magnesium are blown into the Bunsen flame. An effective technique is to blow the material from the surface of a thin sheet of asbestos.

Experiment 7. A mixture of zinc powder and sulfur is ignited by the Bunsen burner flame. Under the cover of the flame and the smoke, the alchemist obtains a fluorescent stone. (Exp. 8.)

Experiment 8. A fluorescent mineral (*e.g.*, zinc sulfide) or an ordinary stone, painted with fluorescent paint is held in such a way that the audience may see the fluorescence. One method involves the use of a spot light with a proper filter. By the second method a number of argon lamps (at least six of the 2-watt size) are grouped in such a way that the stone may be held in their light. The lamps are mounted close to the table, but in a fixture which conceals them from the audience.

Fluorescent paint and the spot-light filter may be obtained from A. Strobl, 35 W. 52nd St., New York City. An invisible green (invisible in ordinary light, that is) suitable for this experiment may be obtained at $1 per ounce ($1.50 for two ounces) and a 6½" x 6½" glass filter at $5. Argon lamps may be purchased from any science supply house.

Experiment 9. For this experiment, a controllable explosion is needed. Hippodrome flashes are excellent for this purpose. They may be obtained from: Pain's Fireworks Display Co., 22 Park Place, New York City, at 25¢ each. An easily broken dish, or bowl, of clay may be made with the Hippodrome flash imbedded in the bottom. A *thin* coating of clay covers the flash, thereby insuring the breakage of the bowl. The wires of the flash extend through the bowl. These wires are connected to a circuit composed of some source of current, and a switch. Any current will do, from a dry cell to the house circuit. In the latter case the possibility of a short after the explosion must be guarded against. As the alchemist turns from his table to get the quicksilver, an assistant off stage throws the switch, or better still, because safer, the alchemist may throw the switch while his back is to the audience. This experiment should be tried at least once before the performance to gauge the extent of the explosion.

PROLOGUE*

In the ageless quest for knowledge, man's efforts have encompassed many arts which have later proved to be only stepping stones to the hard gotten truths. Among the more important of these was the art of Alchemy which influenced men's minds for centuries. From the time of the ancient Chinese to the present day, the search for the Philosopher's Stone and the Elixir of Life have been quests of this art. The Philosopher's Stone was a mystical substance which had the power to transmute base metals into gold. The

* Written, and given as an introduction, by another member of the class, Hugh Brown.

Elixir of Life, when drunk, gave eternal youth to the drinker. We all know that the Alchemists never attained their goals. Yet, even if Alchemy never succeeded in its purpose it did serve the very important task of keeping alive the arts of science throughout the Dark Ages.

Alchemy has never lost its lure to some. It is in an attempt to portray some of this fascination that this play was produced. In it, we will try to portray the true Alchemist in all his pitiful glory. Many of this class were tricksters and charlatans, resorting to connivance as a means of earning their living. But in spite of the presence of these parasites there were a few who were really devoted to their art and would and did sacrifice everything in this fruitless search. This is the type of alchemist we portray today. Little need be said of the other characters except that they reflect the desire of many persons through the ages to use the Alchemist as a tool for gaining wealth and power.

Now we present "The Fabulous Quest."

THE FABULOUS QUEST

by

ALAN GLENDENING

and

WILLIAM LUM

Characters in Order of Appearance

Sir Robert Tregennis..... An Impoverished Nobleman
Lady Frances.....Sir Robert's Wife
Michel.....Servant of Sir Robert
Mentor.....The Alchemist
William.....The Alchemist's Assistant
Lord Devon.....Mentor's Rich Sponsor
Thorn.....Devon's Counselor
Landlord.....An Innkeeper
Julia.....The Alchemist's Daughter

Scene 1.....Sir Robert's Home (Evening)

Scene 2.....Alchemist's Laboratory (Following Day)

Scene 3.....A Room in an Inn (Later Same Day)

Scene 4.....As Scene 2 (Following Morning)

Scene 5.....As Scene 3 (Several Weeks Later)

Place—England
Time—17th Century

SCENE 1

Setting to represent room in the castle of a nobleman. Props actually needed are desk, two chairs, one of them at desk, wine bottle and glasses. See explanatory note on scenery, also.

Robert: Michel—Michel! Where are you?

Michel: (Enters left) Here I am, Sir Robert.

Robert: Lock up the house for the night, Michel.

Michel: Yes, Sir Robert. Goodnight, madame. Goodnight to you, sir. (Bowing.)

Robert: Goodnight.

Lady Frances: Goodnight, Michel. (Exit Michel.)

Robert: Now that we are alone, my dear . . . We must talk seriously of certain matters.

Lady F.: Is something wrong? You seem so worried.

Robert: Oh, there's no concealing it. You must know, though I have tried desperately to avoid it. Here, read this. (He takes letter from desk and gives it to her.)

Lady F.: (She reads letter.) "Dear Sir, . . . I regret to report that the ship 'Golden Star' in which you invested 10,000 pounds was lost off Hatteras last month." But why did you put your money in such a risky venture? Surely you don't fall prey to every money-making scheme!

Robert: No, my dear, and I didn't want to tell you . . .

Lady F.: (She interrupts.) It matters not greatly, does it? After all this ten thousand pounds doesn't really mean so very much to us.

Robert: I fear it does, Frances. The whole truth is that we are ruined. You see my father's legacy was not as great as I had at first thought. We have lived richly upon it. We have entertained royally. But our extravagance has consumed our inheritance very swiftly. I knew how miserable you would be without this sort of life—the kind of life, after all, that we are both so used to. I was desperate. I risked everything in this venture on the one chance of regaining everything. But—I have lost.

Lady F.: Oh, Robert, there must be something we can do.

Robert: There seems to be no way out.

Lady F.: If only there were some quick, easy way to obtain credit, or gold. (She is bemused for a moment.) Wait, Michel said something the other day. He'll

be in his room. (Rings for servant.) He mentioned something that might help us . . .

Robert: What was that? (Enter Michel.)

Michel: You rang, sir?

Lady F.: The other day, Michel, you told me something about an alchemist in the neighborhood who had discovered a way to make gold, I believe it was. Tell my husband what you told me.

Michel: Why, my lord, there is little to tell. This old greybeard has his workshop on the main road at the bottom of North Hill. A very devil's den with soot blackened walls and bubbling bottles all about. It is said that his patron is Lord Devon. (Robert exhibits signs of displeasure at the news.) This alchemist claims that he has just discovered the secret of the Philosopher's Stone. As everyone knows he who possesses the Philosopher's Stone can, by its aid, make all the gold that he wishes. Beyond these facts, I know nothing.

Robert: Very good, Michel. You have helped us inestimably. You may go.

Michel: Thank you, sir. (Exit.)

Lady F.: What think you of that?

Robert: If we dare believe it. . . . And why should we not? Lord Devon supports him and Devon is nobody's fool.

Lady F.: Then do you think we could? . . .

Robert: Yes, yes, dear wife, I begin to hope again.

Lady F.: And I, too. If we can get from this alchemist the secret of how to make gold. . . .

Robert: That's easier said than done. If Devon is backing him we'd best be very careful. He will allow no interference in his schemes. That grasping devil's not one to neglect his own interests.

Lady F.: No, but we must get the information. It's our last chance. (She arrives at a sudden decision.) Robert, I will visit this alchemist tomorrow on some pretext and attempt to draw his secret from him. Meanwhile, you make some provision for leaving the country in case of failure. There's always that chance.

Robert: Very well. . . . Ah, my friend, Captain Dunwell—he sails for America within the month. I will see him. Meanwhile, do you visit the alchemist.

Lady F.: Come, Robert. Let us to our beds. Tomorrow bids fair to be a trying day.

Robert: Yes. But wait! I propose a toast! (He pours two glasses of wine.) Tomorrow and success! (They drink.)

Curtain.

SCENE 2

Alchemist shop. Bottles, tubes, retorts line the shelves. There is a fire in the open hearth. William, the assistant, is straightening the shelves. Mentor is working at an experiment.

Mentor: Ah, subtle gold, why hide they face in the baser metals, while all the world waits to see thy shining lustre. I have distilled sacred metals of Venus, Mercury, and Saturn, and thus fused them into a most glorious metal. To this I have added the smallest part of *(Exp. 1)* oratrexatus of silver to bestow upon it the power of transmutation. Then did I heat and distill a second, and yet a third time. Under the signs of Mars and Venus, I fused fiery copper, the metal of the red planet. All these did I according to the sacred doctrines of Hermes Trismegistus, whose formulas I have so diligently perused. Then will I have produced the Philosopher's Stone, the power of transmutation will be mine. (To William) Do you understand? I will be the richest man in the world. Do you hear? (His voice rises with ever increasing excitement.) The richest man in the world! My money will command the respect of kings. No longer will I bow and scrape. . . .

William: Master, master, calm yourself, master. You know not what you say.

Mentor: (Paying no attention. Rising, and walking about feverishly.) No longer will I grovel before men. No longer will I depend upon others for subsistence. It will be I who will be the master. (His voice gradually dies lower.) All the hopeless, lonely years will bear rich, golden fruit. . . . (He continues to mutter under his breath, as he gradually lowers himself to his seat at the laboratory table.)

William: (Shakes his head sadly.) What face do I see there? 'Tis surely not that of any sane man. The lust for riches has driven him insane.

(Lady Frances enters and, seeing Mentor absorbed in thought, speaks to William.)

Lady F.: Would you tell your master that the Countess Elspeth would have word with him?

William: Yes, Milady, . . . Master?

Mentor: Eh. . . . What is it? (Gruffly).

William: There is a lady who would speak with you. She's the Countess Elspeth.

Mentor: Um. . . . All right. (Will exits. Mentor slowly and unwillingly directs his attention at his visitor. Slowly there dawns on him that the person

before him is one of quality, a noblewoman. This is reflected in a gradual change in his manner from that of gruffness to that of an almost servile graciousness.) I'm honored. It is not often that I see such a noble lady as yourself. What can I do to help you?

Lady F.: (Deliberately over-emphasizing her anxiety) At last, sir, I am blessed to find you in. Many times I have come here to find that you were away, searching so your boy says, for some rare ingredient for your Philosopher's Stone. But enough—I'll tell you my reasons for coming. (She conceals her real reason in a pretended interest in the alchemist's potions.) Your fame as a concocter of potions and elixirs has spread afar. You are said to have worked miracles with your art.

Mentor: Oh, that is too great praise, milady. I do but work small deeds with potions of love, hate, success, revenge—nothing important.

Lady F.: Oh, praise God. I knew you could help me. You did mention love potions, did you not?

Mentor: Aye, milady.

Lady F.: (Still dissimulating.) I am so glad. My husband, the Count, grows daily more cold, more unloving.

Mentor: Whom do you suspect?

Lady F.: (Bridling.) Sir, you forget yourself.

Mentor: Your pardon, milady. About the potion? . . .

Lady F.: Ah, yes. What manner of potion would you advise?

Mentor: (His manner in this speech is one of amused condescension. He is really not much interested in these potions, nor really a believer in them. However he is not above taking advantage of another's credulity to turn an "honest" penny.) There are two varieties. The first is made of rare herbs such as have been used since ancient days. Indeed, the fair Helen employed this drug to win the handsome Trojan Paris. It is as gentle as Spring. No more than the essence of roses gathered in the light of the moon. The other potion will also work wondrous results. It is derived from the roots of a sacred tree. 'Tis said that the goddess Venus did use this very potion to hold the love of the mighty god Mars. I need not say that it must be employed with great care. One lady's lover did die of sheer love, because of an overdose of this potent concoction.

Lady F.: (Seemingly much impressed.) How very sad! If you don't mind, I prefer the first potion.

Mentor: 'Tis no difference. (He goes to his workbench and begins mixing chemicals.)

Lady F.: (Taking advantage of this opportunity to further the real purpose of her visit.) Tell me, have you really produced the Philosopher's Stone, as people say?

Mentor: Aye, 'tis indeed true and with this stone I will turn base metals into the purest gold. (He continues with his experiments.)

Lady F.: It is said that you will sell your secret to the man with the greatest offer.

Mentor: (His fundamental loyalties attacked) That is indeed false. I mean to guard my secret as my life and no man but Lord Devon, who has aided me, shall share the profits with me, no matter what he offer. The search for gold has been my life's work ever since I started as a starving apprentice. Now my quest is finished, I may look back on my life of misery and privation and be happy as I have never been before. Aye, indeed, and my daughter may now marry a nobleman. 'Twill be the dowry that makes the difference.

Lady F.: But suppose the reward were large indeed?

Mentor: No. I am adamant. (Getting on with the business at hand) Ah look. (He brings over the two bottles he has been mixing.) In this flask is contained *(Exp. 2)* the essence of love, the potion for which you ask. I will demonstrate its powers. (He points to the other flask.) Herein we find the essence of dead love. Behold! (He pours the first liquid into the second and chemiluminescence takes place.) The light of love is again renewed. Is it not a wondrous potion?

Lady F.: It is indeed. (Her tone belying her words) I know not how to thank you.

Mentor: 'Tis nothing, milady. Your gracious presence—plus the small sum of ten pounds, is all the thanks that I am wanting.

Lady F.: But ten pounds?

Mentor: Yes, milady, ten pounds.

Lady F.: Well, I suppose I must.

Mentor: I'll have that no good assistant of mine deliver this to your abode. Hey, imp!

Quick Curtain.

SCENE 3

The room of an inn, just off the main tap room. Table and several chairs constitute the main props. Enter Lord Devon and his aged counselor, Thorn.

Devon: Well, my little Thorn, what news have you today? You asked me earnestly

to meet you—and here I am. (Sarcastically, making a bow toward his companion.) Indeed the whole affairs of my estate are in your capable hands. So when something important occurs, I must consult you.

Thorn: I have pleasing news for you, my Lord Devon. You have, for many years given financial support to the alchemist, Mentor. It seems that at last you may expect a return from this investment.

Devon: How so? Has he discovered a gold mine in his back yard? That's the only gold he'll find, I'll warrant. (Laughs.)

Thorn: Laugh not, milord. He has, so he says, discovered the long-sought-after Philosopher's Stone. With this he can turn any other metal into gold or silver. Since you gave him aid with the understanding that half of any huge profit he made would go to you . . .

Devon: Ah, my little sharp thorn, I begin to see.

Thorn: Yes, master, you can readily see you may double or treble your fortune. Nay, unlimited riches will be yours.

Devon: The prospect does not displease me. Not that I am in great need of wealth but to realize the tremendous possibilities is a conception almost beyond mortal imagination. To be able to make one's own gold like bread—or shirts!

Thorn: (Ingratiatingly) If this business works out, I trust, my lord, that there would be some small stipend accruing to my humble self for past service and faithfulness through the years, you know. You have been saved some considerable embarrassment by my—shall we say—discretion. You recall that little incident of the countess' maid, my lord. (Laughs.) It would have been most disadvantageous if such an affair had come to light.

Devon: (Coughs, in embarrassed fashion.) Quite right, faithful servitor, you richly deserve payment. How I shall miss your genial lack of scruple—(sinisterly) once you are dead.

Thorn: (Ignoring the last remark) Thank you, my lord.

Devon: Tomorrow morning we will pay a visit to Mentor. I must be shown this miracle. You will give orders to the coachman. (They exit.)

Enter Lady Frances and Sir Robert.

Robert: But couldn't you find any way to make him disclose the formula?

Lady F.: No, he told me quite frankly he would guard the secret with the greatest caution. It seems that it is something that he has sought all his life.

Innkeeper enters.

Robert: A bottle of your best port, my host. (Landlord leaves.) 'Twould seem impossible to get the formula from him. Is there anyone else who might know the secret? (Landlord enters with wine. Robert pours into two glasses. They drink.)

Lady F.: His assistant may possess the secret. (Pause.) He might be reached, too—by flattery or perhaps a bribe.

Robert: At all events we must hurry. Our creditors will descend upon our property within the month and everyone will know our disgrace.

Lady F.: The assistant is indeed our last chance.

Robert: Yes, tomorrow morning I'll go to the alchemist's and speak to the boy. If I fail we must leave for America. I pray God that assistant is of dull wit.

Curtain.

SCENE 4

The alchemist's laboratory as Scene 2. The next morning William is discovered straightening up the laboratory, whistling softly to himself. He stops work and sits down to whittle a piece of wood. Julia enters and taps him on the shoulder.

Julia: (Curtsying) How are you on this fine day, Sir Alchemist? In best of health, I trust?

William: I am very poor on this not so fine day; my health is very ill, and what is more, don't call me Sir Alchemist!

Julia: You seemed to be whistling very cheerfully but a moment ago.

William: I was only trying to keep from falling asleep. Oh, me. Your father had me up all last night with his experiment. He'll be down in a few minutes to continue. He thinks he is near the end of his quest and I know I am at the end. I have had no sleep for a day and a night.

Julia: Never mind that. Listen, Willie. Father just spoke to me about my marriage.

William: Did you tell him that *we* want to get married?

Julia: Of course not, silly. You haven't even asked me! Anyway, the suitor always asks the father. But that isn't important. My father just told me that I shall marry some noble or knight. He thinks that he will make gold and be able to marry me to some fashionable member of the gentry.

William: Well, if I see him, why I—I'll hit him a clout upon his pate.

Julia: (Taunting) But Will! Just think! I will be a great lady with ten, nay twenty servants to wait upon me. You shall be my stable boy.

William: Stable boy, indeed! And how do you think your fine lordly husband will act? (He mockingly portrays the fop.) Wife, will you be so good as to bring my perfume to my room? You know, Fleur de Stinkum, my exclusive, fragrant odor. Wifie, be a dear and straighten my wig. That last curl is out of place. Fix it, would you?

Julia: Oh, be sensible.

William: Now don't misunderstand me, Julie. (He whispers in her ear.)

Knocks on door.

Julia: Oh, Willie. I'm surprised. I never would have thought you . . . (As they draw closer, more knocks are heard.)

William: Someone's at the door.

Julia: I'd better go. (She leaves, hurriedly.)

William: (Opening door) Come right in, sir. (Enter Sir Robert.)

Robert: Good morning to you, sir. You are the alchemist, no doubt. I am Sir Robert Tregennis of Welshire.

William: I am sorry sir, I am only . . .

Robert: Oh, come now, you are William, Mentor's partner in all this scientific work.

William: But I assure you, sir . . .

Robert: I am told you know of finer potions than Mentor himself.

William: (Flattered) Aye. That is, there be decoctions I can—a-concoct.

Robert: (Simulating) Ah, I am overjoyed to hear it. Indeed, sir, you may well save me from insanity itself. Ha, good man, if you can but free me of this horror, I will pay you back most bounteously. (Robert sits.)

William: And you wish a charm to rid you of this thing?

Robert: Yes, by all means.

William: Did this creature say aught to give you a hint of his nature? If I am to dispel him, I must know about him.

Robert: Yes, he always says, "Give me gold, cold gold, rolled gold, gold gold." The cadence is maddening.

William: Perhaps a gold charm would do it. Have you any gold with you?

Robert: No, I have not. (Pause.) But here—What sort of alchemist are you? Surely you have some gold—or can manufacture it!

William: (Musingly) Perhaps I could make some. Mentor has told me many of his secrets.

Robert: Well, proceed then. You'll be well paid.

William: (Feigning an assurance which he does not feel) You see, Sir Robert, 'tis not a hard task. First I take this black *(Exp. 3)* powder and add this liquid. (He sets this aside.) Now I take these two *(Exp. 4)* liquids and mix them. (Smoke is generated.) Mentor says that the fires of Hell are being released. (The first mixture that he set aside starts burning.) Oh, dear, something has gone wrong.

Mentor enters, followed by Julia.

Mentor: (Angered) What means this, William? I never gave you permission to experiment in my precious laboratory. How dare you?

William: (Thoroughly deflated) I meant no harm, Master. Please forgive me. I was but trying to make a charm for this gentleman.

Mentor: This once will I forgive you. (Knock.) But if . . . Answer the door.

William: Yes, master. (Enter Lord Devon.)

Devon: (Patronizingly) Ye gods, Mentor, such a commotion! Are you trying to transmute the whole shire into a pile of dust?

Mentor: Your pardon, milord. My apprentice made a mistake.

Devon: (Seeing Sir Robert, he speaks to him in seemingly a bantering fashion. The enmity between the two is nonetheless revealed in his speech and that of Sir Robert.) Why, 'tis Sir Robert, himself. What business have you here? Can *you* have come for some token? In the old days you were ever the reckless one who scorned potions and charms.

Robert: 'Tis only some small purchase. But, why do I find the great Lord Devon in this den of bad smells?

Devon: May I ask you the same question?

Robert: Oh, I came to purchase a charm.

Devon: How charming. Sir Robert, a pun. I just made a pun. (He laughs.) But, I say, if it's a love charm for your wife you're after, why it will take something more substantial if she hears about that little, black-haired baggage down at the inn.

Robert: Will you never cease maligning me in public, Devon? You've done it since ever I knew you.

Devon: (Ignoring Robert, and turning to Mentor) But about my business here, Mentor. I hear you have at last produced the Philosopher's Stone.

Mentor: Yes, indeed, milord.

Devon: And with it, you may make gold?

Mentor: That is indeed the truth, milord.

Devon: Fine. Now would I like to see you make gold.

Mentor: Aye, milord. I will in a few minutes produce the first gold ever made by man. (He starts arranging his equipment.)

Devon: If this experiment is a success, I can expect an enormous return from it.

Robert: A return? Why should *you* need a return? And what have you given?

Devon: Why money, materials. What more?

Robert: (Bitterly) Money means everything to you.

Devon: (Gloatingly) But still I get the return.

Mentor: I am about to begin.

Devon: Excellent.

Mentor: (Throughout the balance of this scene, Mentor is in the grasp of the same emotions that possessed him in scene 2. His preliminary experiments have led him to believe that this final set of experiments will produce the gold, which has been the goal of all his life's endeavors. Rising excitement up to the time of his experiment's failure, is followed by a depth of depression from which suicide is the only escape.) First do I cleanse myself in the all consuming fires of Hephaestus. (He sets *(Exp. 5)* fire to his hands.) The spirits are driven from my body. All is in accordance with the planets and the stars. But first I must prepare the air around us for the noble experiment. I *(Exp. 6)* do take equal parts of the moon (he throws powdered iron into the Bunsen flame.) and the sun (He throws powdered aluminum into the flame) and do marry them with the element, fire. Now do I combine all elements into one. (He tosses a pinch of powdered magnesium into the flame.) Once, twice, thrice, do I thus combine the earthly elements.

The air, now being devoid of the negative influences of the moon and sun is receptive to the great experiment about to be fulfilled. The sun of Heliopolis is to be satisfied. (He *(Exp. 7)* directs the flame at a pile of zinc and sulfur, as he says—) At last the will of the godly Hermes Trismegistus is to be consummated. (Under the cover of *(Exp. 8)* the smoke and light, he brings out the fluorescent stone.) Lo, the Philosopher's Stone in all its glory. Is it not beautiful? It will heal the wounds, cure the woes of mankind. Likewise, it will transform any earthly metal into the yellow metal upon contact.

Devon: Yea, it is indeed beautiful, but make some gold. I want to see you make gold.

Mentor: (Almost reverently) Aye, now will I make gold. I place the stone in a bowl. Then I add to it, quicksilver, element of the moon, which I have long kept for this moment. (He turns *(Exp. 9)* to get the quicksilver. There is a shattering explosion from the bowl.)

(Mentor turns, not too quickly, for he is an old man. Gradually the realization of what the explosion has meant, creeps over him. His whole manner changes. He becomes a broken old man.)

(Weakly, hesitatingly) The experiment has failed—and with this failure my life's meaning and purpose is shattered. I am an old man. (He lowers himself, slowly, into his chair.)

Exit, all except Devon.

Devon: Could you not try again?

Mentor: That can I not. This method has failed, and there is no time for another. (Exit Devon. The lights have gradually lowered. Mentor's head is in his hands. Pause.)

'Twas a vain, futile quest. But it was the task of my life. I have failed. Thus my life is no more. (Slowly, painfully, he forces himself erect, takes a small vial of white powder [actually sugar, or table salt] pours it into a glass of water on the laboratory table, and drinks.) May the world profit by my example! (He slowly sinks back to his chair.)

Curtain.

SCENE 5

As scene 3. A few weeks later.

Thorn: Surely, now that the old bag-of-rags is dead, you'll not support his daughter.

Devon: I will.

Thorn: You'll have that dumb Willie on your hands as well, you know.

Devon: Oh no. He'll be on Julia's hands. Heaven help him. She's going to have all the money.

Thorn: But they'll never pay you back.

Devon: You're wrong. They shall continually repay me with entertainment. I shall enjoy seeing Julia turn into a practical and masterful housewife, while Willie turns into a henpecked hewer of wood and drawer of water. Money always affects women so.

Thorn: You would know, my lord.

Devon: Where is the cursed landlord. (Pounds on bar.) Ho, there. Service, demn it. We perish of thirst! (Enter landlord tying on apron.)

Landlord: At your service, my lords. What'll it be.

Devon: Rum.

Thorn: Ale. (The landlord quickly brings the drinks and stands by the table as they drink.)

Landlord: (To Devon) You like the rum, sir? (Devon has swallowed the drink in a gulp.)

Thorn: 'Tis his lordship's ailing throat.

Devon: Yes, a distressing malady. (He coughs, pours another drink.)

Thorn: Only rum will aid it.

Landlord: (Sampling his own wares) Aye, my lords. I, too, am so afflicted.

Thorn: Ah, fellow sufferers! (Robert and Lady Frances are about to enter. They pause, on seeing the occupants of the room, and are about to withdraw, when Devon speaks.)

Devon: Do not haste away. Welcome, Sir Robert. And your wife—Madame, I'm charmed, indeed. (Bows exaggeratedly.) I so seldom see you, Robert—with your wife.

(To Lady F.) We must meet more often. But come now, partake of mine host's good cheer with me.

Thorn: (Somewhat drunkenly) And me.

Robert: We cannot stay. We have an important engagement.

Lady F.: Yes, you know how relatives are.

Devon: But come. Stay here. Thorn and I will gladly vacate for persons of your quality. (They leave.)

Robert: (To the landlord) Wine for the lady and myself.

Landlord: Yes, sir.

Robert: Fortune is with us. Our presence in this dive will ne'er be suspected. (They sit down at the table. The landlord enters with the wine. They drink.)

Our ship leaves tonight. The mail coach that stops here should get us to Bristol in time. Now that our ruin is complete, I seem to feel relieved. For once our course is clear and direct.

Lady F.: I can't say as much. The very thought of leaving this civilized country for a howling wilderness—horrible! The people are all savages and there is no culture or refinement to be found. I shall be miserable.

Robert: Now, now Frances. America's not so bad as all that. There are other people of our class there, and where there's an Englishman you'll find culture, you may be sure of that.

Lady F.: I'll not argue but let us leave this awful inn. The smell is unbearable, and I'm getting a headache.

Robert: Very well, my dear. We can wait for the coach outside. (Exit.)

Julia and William enter. They sit down at the table just vacated.

William: (Importantly) Two ales.

Julia: Oh, Willie. I'm so excited. I have everything planned out. We can buy that little house overlooking the market. I've always wanted to live in town and this is our chance. We can use some of father's old furniture in the house, although most of it we'd better use for firewood. We'll have the banns cried in church this very week, though of course we must wait a decent period before getting married—because of father's death, you know. Poor father! (She muses for a moment.)

And after we're married, you can sell fish in the market and we'll be very prosperous and happy.

William: (Questioningly) Fish?

Julia: Fish, dear.

William: (Resignedly) Fish.

LIFE IS SO SIMPLE *

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It was early Spring. The nights were long and cold, and the forest plants were just beginning to peek out of their seeds to start their climb toward the sun. The trees were again lifting their limbs, bent low from the winter's snows. Everywhere nature seemed to be unfolding her wares and setting up shop for the coming season. A quiet little stream picked its way leisurely along, widening a bit here, narrowing for a jump over some rocks, then pouring out into a placid pool, green with moss and water plants.

A fat, lazy newt crawled from its hiding

* EDITOR'S NOTE: *We liked this and believe our readers will, too. Perhaps the reader will be tempted to try his hand at writing a story of interest to pupils. Let us have your literary-scientific efforts.*

place under a half rotted log and dragged its lizard-like body toward the stream. The sun felt hot and dangerous to her soft brown skin and she hurried a bit to reach the cool water again, stopping only to snap at a lone unsuspecting bug on the way. Once into the water, she swam to the bottom and searched the mud and plants for more food to satiate her overwhelming appetite. Not satisfied, she swam toward the surface again and picked her way through the rushes and the water lilies. The stem of a water plant touched her belly as she passed over it and her arms instinctively grabbed at it, pulling it hard against her. This seemed better than the food she had sought and she stayed there, hugging the stem, and feeling a strange satisfaction. After an hour or two had passed, her grip on the stem loosened and she fell once more to the muddy bottom to doze contentedly.

Left shimmering on the stem was a large cluster of clear, jelly-like balls, stuck fast to the stem, almost as if they had grown from it. At the center of each ball was a little sphere of some dense material, brown on the top and shading into a creamy white on the bottom. These spheres were the newt's eggs. Each was but a single cell, ready to start building of itself a copy of the animal resting in the mud below. As the eggs had come into contact with the water, they had fallen toward the lily stem and the jelly-like covering had sprung up, binding them to the stem, and protecting them from being crushed when the wind rustled the lilies, or from being eaten by a hungry enemy.

Soon a small pit began to sink in at the top of each egg and, as the pit grew deeper, it widened into a furrow which cleaved the eggs into two halves. Another sank on each of the halves and stopped only when it had cut the mass into four wedge-like quarters. Magically, as if an unseen hand had tied a loop around the equator, the mass began to constrict and soon became a ball with two layers of four cells each—the upper layer destined to shape itself into an embryo, to be fed by the lower layer of yolk material. Each cell continued to cleave again and again, as if hundreds of tiny knives had been thrust toward the center of the group, until the cells were so small that the whole mass once more looked like a smooth sphere, still brown on top and white below, but now larger and hollow. As breezes gently waved the lily stem back and forth, or when a fish rudely brushed against it, bending it low for a moment, the embryos within the jelly balls rolled so that the brown was always uppermost. One very good reason why the balls refused to be rolled over was because they were half filled with loose, sticky balls of food material which acted like the lead bottom of a roly-poly doll.

Soon a very strange thing began to happen for no apparent reason at all. A new pit appeared on one side of the ball. But this time there was nothing solid for it to cut into and so it just sank into the empty space within the sphere, pushing in a hollow, finger-like projection which crept carefully over the top of the pile of food, feeling its way along until it reached the opposite side of the cavity, forming a tube within the sphere. The tube pushed vainly against the side wall of the sphere and getting nowhere, had to content itself with merely making the sphere slightly oblong. But the tube was full of energy and had to move somehow. Forward motion was impossible, so it tried growing upward until its whole length was pushing on the ceiling of the chamber. But the ceiling would not be pushed about. Restlessly, the tube pinched off a solid rodlike strip of material from its own roof and left it lying under the ceiling of the cavity, as a supporting rod to hold up the ceiling while the rest of the tube went off in search of new space to wander in. And wander it did.

From its sides it sent off branches which extended the whole length of the cavity. Some migrated to the very outer limits of the chamber and came to line the whole sphere, gathering together here and there in bunches which formed themselves into masses of fibers. Other branches crawled to the floor of the chamber and formed themselves into a long hollow tube, with a wider part to it which soon started to pump in a slow, steady rhythm. From along its floor, the restless tube sent out buds which grew until they formed sacks filled with mazes of hollow, winding tubules. Still more buds were given off, large and small ones, forming masses of solid material. Next the tube gave up this business of sending out buds and, instead, stretched itself until it was so long and slender that it was obliged to coil into a spiral in order to fit within the confines of the chamber. Then something happened which seemed to satisfy the restless tube. The tip of its front end, which had been pushing against the wall for so long, melted a tiny hole in the wall and broke through to form a mouth which led from the outside into the rest of the tube, which had been slowly shaping itself into a digestive tract in preparation for this big event.

But while all this had been taking place inside the embryo, the outside had not been idle. On the top surface a pair of parallel ridges long since had risen up, fallen toward each other, and then they fused as if a zipper had been pulled along the length of them, leaving a hollow tube beneath a once more smooth surface. The front end of the new tube was wider than the rest and soon grew into a complicated structure full of cross fibers. The rest of the tube sent out fiber strands to all parts of the whole embryo—into the bundles which had gathered along the inside of the body wall, into the tube which had given so many buds, into the buds themselves, even into the pumping organ, so that soon there was not a speck of the whole mass, inside or out, that was without a fiber path running to the complicated cross fibered structure.

A pair of pits sank into the front end of the body mass and drove on until they formed a pair of nasal passages which lead into the back of the mouth. Another pair of pits sank in, the front of them cleared and left a pair of eyes. Another set of pits shaped into ears. The back of the mass grew into a long slender tail. Something floated against the side of the tail, and the tail impulsively jerked away. The body twitched nervously. The jelly ball which had held the embryo a prisoner had melted away. Days passed. The body twitched more strongly. And then one day a bit of debris tickled the tail. A wave of motion rippled the whole length of the body and the motion pushed it through the water. Feeble waves of wriggles grew into stronger waves, and soon the animal was strong enough to swim; free to swim through the forest of grass roots and search for specks of food to put in the hungry mouth.

Weeks passed and the little creature sprouted two pairs of toothpick-like legs which soon grew larger and stronger until they were able to do part of the work of moving the animal about. Smaller grew the fins on the tail, larger grew the legs. The gills with which the animal had been taking air from the water began to dwindle, and the need for more air was felt. Cautiously a tiny nose appeared above the surface of the stream and drew in a breath of fresh, dry air. For days these experiments in breathing went on, and the fast growing legs would sometimes carry the animal close to the edge of the shore.

Then one day the young newt peered as far up onto the shore as it could. The view seemed extremely inviting. Carefully the little animal climbed onto the shore, dragged itself up the bank, snapped at unsuspecting bugs, and hunted for a musty log under which it could doze contentedly. Life is *so* simple for a fat, lazy newt.

INDUSTRIAL PROCESSES OF LOCAL INDUSTRY TO VITALIZE A GENERAL SCIENCE PROGRAM

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The new orientation in the field of secondary education does not find it essential to fit the child to the subject matter, but rather requires that the educator study the child, not out of relationship to his environment, but rather in terms of his evolvements with the culture in which he grows as an active dynamic organism that grows in interaction with a dynamic environment.

The experiences that the learner faces occupy a key place in the curriculum. The activities provided in a textbook do not offer all the experiences necessary to meet the needs of pupils in communities of a widely differing nature. In an industrial community, where the majority of the pupils are planning on going into industrial work, a vital part of the school program should be to provide worthwhile experiences of an industrial nature.

The problem of this report is in the field of general science and is concerned with the study of industrial processes which may be used by the pupil to vitalize his work in the junior high schools of Newark, Ohio.

Specifically, this report presents:

(a) A method of obtaining certain pertinent industrial processes
(b) A plan for using these industrial processes of local industry in a general science program
(c) The philosophy in the school making maximum use of such a program
(d) A list of processes that may be found in local industry which may be used in such a plan
(e) A list of industries or plants concerned with various industrial processes, and
(f) A number of guide sheets to be used by the class, a committee, or an individual working with some particular process.

A résumé is presented of a study of community and pupil interest as a basis for curriculum revision. The results of the findings of this survey are in accord with the proposed program. An analysis of the number of pupils dropping out of school in the last 20 years (more specifically, those obtaining work permits) showed that the greatest number of drop-outs occurred during Grades 7–9. The implication that this has for the subject under discussion is the fact that these individuals are now going out into the world of work; that these individuals have not had any experience with any work of a physical science nature; and as a result will go in their life work without knowledge which will be of great help to them or experience which might have been gained from a functional physical science course.

There is concern only for the processes which can be carried over into the general science laboratory. Expensive, complex or technical processes are necessarily eliminated, or those requiring skill beyond the aptitude of the average junior high school pupil.

The data were compiled from:

(a) Teacher and pupils' interviews with plant managers and personnel directors
(b) A survey of Reports on Industrial Processes that have been used in the science department in the last ten years (since this program has been carried on for a number of years, this material is extensive)
(c) Information offered by the local Chamber of Commerce.

In this study are described certain curriculum revisions with particular emphasis upon the use of industrial processes for a general science course. Since the philosophy of the school is based upon the interests and the needs of the adolescent, the materials of instruction, including texts, are used only as a means to an end.

The experiences involved in working out an industrial process in the school science laboratory are of such nature that they should increase the understandings of the learner about Newark industry, should develop an awareness on the part of the pupils regarding other processes, and lastly, should eventually lead to a more intelligent citizenry in the community.

The major considerations that prompted the undertaking of this study are as follows:

(1) The initiation of a curriculum revision program in 1936 under the direction of H. B. Alberty, of the Department of Education of the Ohio State University;

(2) The activity of the science department of Newark in attempting to relate the work more closely or more nearly to fit the needs and interest of the pupils engaging in this work in the science area;

(3) A need for the refinement of the technique already in use by the pupils and teachers in making a survey of an industry, in actually carrying on an experiment in the school laboratory, and in reporting on these processes;

(4) The need for the description of an actual process as it is carried on by the pupil;

(5) The increasing number of young people going directly from high school into industry, particularly local industry;

(6) A need for correlating this program with the various other phases of the school program and with education in general.

LIMITATIONS

In dealing with industrial processes as they relate to general science, it has been the purpose to provide a more intelligent citizen in the community with respect to local industry, and not to emphasize particularly the vocational aspect.

Local industry has been considered as that to be found or reached by the pupil without entailing too great expense in transportation.

In dealing with industrial processes the progressive teacher will use movies, slides, various types of exhibits, tours or any other of a wide variety of techniques by which the objectives that have been set up may be reached. Emphasis in this work has been placed upon the tour or individuals actually visiting a plant, factory, or research laboratory as a means of obtaining information about industrial processes.

The term industrial process might be thought of as any activity involved in the transforming of raw material into a finished product including certain chemical, biological, or physical activity.

OBJECTIVES

In the development of a course in general science, the dominant, ultimate objectives of general education must be kept in view at all times. These objectives should be based upon a forward-looking philosophy of human needs and upon the obligations of school education to contribute directly and effectively to the outcome which that philosophy contemplates.

Outstanding among these outcomes is the coordination of the emotional, intellectual and physical interests of the growing child to make effective his contribution to society. In working with industrial processes these outcomes may be developed through the practice of reflective thinking; certain aspects of which are involved in the use of the scientific method, namely (a) interpretation of data, (b) application of principles, (c) nature of proof, *etcetera*.

A survey of educational literature has indicated that there is an emphasis upon an active community-centered school where the youth of school age are free to spend a certain amount of time outside of the school building and grounds for the purpose of participating in the community in the area of science.

Writers have advocated that pupils engage in activities tending to better living in the community of which they are a part. Such activities as outlined in the study should give vitality to the secondary school and to the community life as a whole, and make for greater civic cooperation and more intelligent citizens.

In this report are described certain curriculum revisions with particular emphasis

upon the use of industrial processes for the general science course. Since the philosophy of the school is based upon the interests and needs of the adolescent, the materials of instruction, including texts, are used only as a means to an end. Hence the use of industrial processes in the school laboratory is in the category, merely used as a means to an end.

There are presented a list of various industrial processes. These have been worked out, some by the students, some by the instructor, and some by the various men associated with local industry. These are arranged according to the similarity of process and also according to the similarity of industry, or the various processes found within one industry.

A plan is presented for making a general study of an industry.

In a general summary the following trends in science in the secondary school are outstanding in a study of the literature bearing on the problem:

(1) The demand for vital and enriching problems in the immediate environment of the pupil is being met by a survey or investigation of pupils and community interests.

(2) The local industries of a community, working harmoniously with the schools, may develop a co-operative program, particularly the study of industrial problems and processes.

(3) Industries are in a continuous process of reconstruction and certain indications are presented to show that the schools are aware of such change in attempting to present learning experiences in line with these changes.

(4) The awareness of change, on the part of the pupil, aids in the stable developing of the pupil's personal philosophy.

(5) There is a presentation of arguments, both for and against, vocational training in schools. There seems to be a rejection of the emphasis on college training and the development of scientists in an extremely narrow or technical field. Industry is interested in orientation, particularly for those of sub-average intelligence, and in the ability of participants to solve problems as they arise.

The philosophy underlying the progressive concepts of general science activity for general education emphasizes a program providing real experiences under favorable conditions for better living. A five-fold objective of science is indicated:

(1) To state in clear, concise terminology this underlying philosophy;

(2) To state the purpose of the general school program, wherein the school meets the needs of the maturing student; and, (a) to state the objectives of the local schools and their alignment with the objectives as stated in the Ohio High School Standards; and, (b) to state my own objectives and to show the relation between them and the general objectives, (1) Alignment with N. E. A. objectives; (2) Program of Science Teaching as recommended in the Thirty-First Year Book of the N. S. S. E.

(3) To show how this philosophy may be translated into a functioning program of the use of industrial processes in the general science area;

(4) To differentiate between the use of industrial processes as a part of general education and vocational education as preparation for entrance into useful and productive employment.

CLASS PROCEDURE

Individuals, through a similarity of interest, may agree to work together upon some common problem. Committees may assign a small part for each member to work out, or each individual may be responsible for the development of the entire report on the process.

An available guide sheet has been worked out which may be used by the individual or by the committee where those interested have chosen to work upon some process that may seem to be necessary in their understanding of some particular problem. These sheets are on file in the school laboratory. This material is an outline which may be used by the student to direct his work. The number of these outlines is being increased each year and since this type of work has been carried on for several years it quite naturally amounts to a rather large collection of guide material.

These guide sheets vary but little in organization; some contain only the mere outline to be followed, while others may have questions which may be raised by the committee and discussed in a full class group. A number of these form sheets or guide sheets have been prepared by the

printing club of the industrial arts department.

It seems evident to the local science teachers and to the writer that such raw material (as these industrial processes), are not to occupy the center of the stage in carrying out the science program. Neither is it desirable for all groups or individuals to feel obligated to work with all of these processes which may be observed. Thus one of the objections to the usual type of guide sheet is in part eliminated by the fact that the pupil is not required to use this form and he is in no sense wholly dependent upon it. In the course of time a complex offering of guide sheets will become available through the efforts of groups or individuals. Pupils desiring to investigate certain phases of some industrial processes may draw upon these guide sheets for much helpful information.

There are certain processes, naturally, which are very well-suited for entire class demonstrations by the teacher, if carried on with the help of the committee of pupils. This procedure, from observation, is the method most commonly used by teachers who do not have available laboratory material or equipment for group use. Many times exactly the material that is wanted for furthering the pupil's experience with these processes can be drawn from standard laboratory manuals; if not, material must be prepared.

Briefly, the plan is to add to the processes already on file (1) new processes which groups or individuals may work out, (2) material which is outlined or suggested by the instructor, or possibly the best method of all, (3) material which may come from other schools or pupils. In this latter case certain schools may draw their pupil population from a section of the city where there is a different type of industrial familiarity, or an interest in a different type of problem. The teacher here must provide suitable and available material upon which the pupil may draw.

ORGANIZATION OF THE COURSE

In the organization of the course, certain guiding principles are considered significant. Among these are the following:

a. The work is planned to be of benefit to pupils who may only go as far as the ninth grade as well as those pupils who are planning to continue their school work in high school and college.

b. For those completing school, the work is directed toward an understanding of the diversified processes of industry which are to be found not only in Newark, but also in larger areas. The ideas are presented systematically, the powers of analysis and synthesis developed, and such development tested in the working out of the processes. Pupils are being trained to consider problems without passion and to reach certain judgments on problems pertaining to contemporary life. An attempt is being made to stimulate sufficient interest in the pupil's carry over into adult life continuing desires for reading and investigation as a vehicle of intelligent investigation and evaluation of Newark's industrial life.

c. It is planned that all pupils are to have a thorough knowledge of basic conceptions and the ability to apply them in so far as it is possible.

d. The materials of the course deals with the basic problems involved in industrial processes.

e. In so far as possible, processes dealing with material under general discussion in the classroom are to be selected for consideration by the pupil.

f. The processes and problems are to be coordinated as completely as possible.

g. The number of processes to be considered by any one committee in any one school year must be small enough to allow a systematic consideration of the phases of those selected.

h. The eighth and ninth year work, as well as the senior high school work, is being planned as nearly as possible to meet the relative intelligence and maturity of the pupils.

i. A psychological approach in the introduction of pupils to problems leading to their ability to organize materials through processes of analyzing and synthesizing data is planned.

j. Provisions are made for the inclusion of adequate lists of reading for each problem, for suitable exercises for the investigation of the different aspects of the problem in various industrial processes in the community and other related types of activity.

k. The course is adapted to the local community as far as possible.[1]

It seems pertinent to discuss briefly some of the questions that have arisen from uni-

[1] Adopted from Ray Ballou "Introducing a Course in American Problems," *Ohio Schools*, May, 1938, Vol. XVI–No. 5.

versity advisors, from pupils, and from fellow teachers in regard to the use of the processes as well as the place of the teacher.

The writer has taken the attitude that the program which is described is not one which can be carried to completion by any one individual. Indeed, this program has been carried on for the last seven years of a total of fourteen years experience in general science teaching and there is a feeling that only a start has been made.

The interview was attained with various plant managers of local industry, and conferences were had with personnel directors to determine some processes which were of direct importance in their particular industries. These individuals were in a better position than the teachers to know what processes might be carried on and what equipment might be needed in the school laboratory so that the pupil might receive the greatest value from his activity.

INDUSTRIAL PROCESSES

In the following list is presented a representative group of industrial processes selected at random from those on file.

Air conditioning, Filters, circulation and ventilation.
Bacteria, Pasteurization of milk, growth of bacteria in test cultures.
Bleaching, Use of sulphur as a bleaching agent.
Blueprinting, Making of blue-print paper.
Chemical processes, Action of baking powder, chlorination.
Carbonated water.
Cement, Use of cement in mortar, testing concrete block.
Clay, Process of making clay into bricks.
Cloth, Glass cloth characteristics, effect of acids and alkalis on cloth.
Coal gas, Making coal gas.
Conductivity, Conductivity of metals, glass, *et cetera.*
Cellulose, Making a cellulose product, making paper.
Density, A table top refinery producing petroleum products, action of a cream separator.
Distilling water.
Elasticity, Bat of glass wool, elasticity of a golf ball.
Electricity, Constructing an electromagnet.
Electro-chemistry, Chromiumplating, copperplating, nickelplating.
Fibers, Strength of fibers, effect of oil, fibers under the microscope, glass cloth characteristics.
Filtration at Water Works Plant.
Flash points of volatile liquids.
Fuels, How to make charcoal, how to make coke.
Glass, Study of silica used in making fine glassware.
Glass wool, As a filter, as an insulator.
Incubator, Use of an incubator.
Light intensity, Study of intensities in a room, a study of scientific street lighting, survey of school lighting.
Light refraction, The refraction of light, use of prisms as refractors, effect of a beam on passing through a clear and frosted piece of glass.
Nature of water, Electrolysis of water, hard water, solvent power of water, water pressure, expansion of water on freezing.
Pressure, Hydraulic lifts, action of force and lift pumps, action of various faucets and valves.
Refrigeration, Action resulting in mechanical refrigeration.
Rubber, Use of sulphur in vulcanizing, study of tire tread and skidding, nature of new and reclaimed rubber, effect of heat on rubber, fixing a cold patch, the actual vulcanizing process.
Seeds, Relative vitality of a seed, air aids germination, a seed becomes a plant.
Silvering a mirror.
Soap and fats, Use of fats in soap making, rendering lard, properties of tallow.
Soil, A study of the factors in the soil aiding in plant production.
Steam, Use in sterilization, use in the steam engine.
Viscosity, To test the viscosity of a liquid.
Water supply, Setting up a model water supply system.
Welding, Properties of oxygen, the acetylene flame.
Yeasts, molds, etc., The action of yeasts, study of the growth of mold.

The industrial processes with which the science department is familiar are also classified according to the various types of processes that are found in one particular industry. This may enable a pupil to save time in investigating an industry which may not be quite so readily accessible.

The names of the various local industries where certain processes are to be found are on file in the Science Department, but are of no concern in this report.

In general science work there has been the plan to follow a rather well-defined program covering a wide variety of units or types of experience.

For illustration let us take the unit dealing with the community water supply. In Newark, Ohio, the water works plant is located at the city limits and easily reached by a bus line. It is within walking distance of Roosevelt School. As a result when this area of experience is encountered by the pupil, a committee will be formed by the pupil and others interested in the same problem.

Formerly, the library, reference books, and the text constituted their only sources of information. Many times the Committees are conducted through the plants by a chemist. The steps in obtaining the water are explained as are the purifying steps of settling, filtration, aeration, and chemical treatment.

This arouses the desire to see how they can work out first hand some of the processes which they have seen.

RECOMMENDATIONS FOR FURTHER STUDY

The study which has been undertaken has raised naturally a number of items for further investigation. A few of these are here stated:

(1) The development of an evaluation of a testing program that will give adequate evidence of the educational outcomes of the course herein developed in terms not only of factual knowledge, but of understandings, skills, attitudes and appreciations—and of problem solving.
(2) The revision of course in accordance with results obtained in testing program, followed by further experimental testing and revision.
(3) Determination of the place of science experiences in the sequence of science courses.
(4) Reconstruction and revision to keep in harmony with developments.
(5) Flexibility of schedule.

In order to carry this work further and make it even more functional certain procedures are indicated:

(1) A system of anecdotal records must be kept; (2) A technique must be developed for interpretation of these records; (3) Records must be kept to note certain aspects of scientific thinking; (4) Student behavior must be noted, indicating growth in aspects of scientific thinking; (5) There must be a further development of the source units dealing with the industrial process; (6) Means must be provided for distributing the guide sheets to all the teachers and pupils throughout a local school system.

GUIDE TO THE LITERATURE OF JUNIOR HIGH SCHOOL SCIENCE

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Literature of value to the researcher in science education and to the teacher of General Science in the Junior High School appears in many forms and emanates from many sources. Teachers usually are interested in familiarizing themselves with content materials from the several sciences as well as acquiring information about modern developments in science education and the findings of investigations into the teaching of their subject. Therefore, the literature to be described in this guide must necessarily include not only the professional but also the technical and popular publications. This opens up a vast field wherein the worker is presented with the difficult problem of selecting materials which are outstanding and of greatest use to him. If he is informed regarding the use of the various available shortcuts, such as guides, indexes, abstracts, reviews, etc., great amounts of time may be saved, and he may avoid unnecessary duplication of work already done. Outstanding items under each of the main headings have been selected, and an attempt has been made to reveal additional sources for those who wish to do exhaustive work.

ABSTRACTS

Science Education began in May, 1929, to abstract articles from educational magazines and popular science periodicals; it

also has a section devoted to "Digests of Unpublished Investigations." The abstracts are signed and are of considerable value to General Science teachers because of the wide range of topics covered. They are grouped under such headings as "General Education," "Science in Education" and "Junior-Senior High School Science."

Education Abstracts, which started with the January–February, 1936, issue, treats outstanding books, articles and investigations in science education under the heading of "Sciences." Each issue has a subject index, and an annual index is included in the bound volumes. Curtis [1] has had published three volumes of digests of investigations in the teaching of science, which cover the period from the early part of the century to 1937. The *Journal of Educational Research* carries each month a few abstracts in the field of science education, and the *Science Digest* abstracts articles of a popular nature.

Deering [2] should be consulted for locating abstracts of dissertations, while Witmer and Miller [3] will provide other sources.

BIBLIOGRAPHIES AND BOOKLISTS

Selected bibliographies under the headings of "Science" and "General Science" are to be found in Monroe and Shore's important *Bibliographies and Summaries in Education to 1935.*[4] This volume covers the period from January 1, 1910, to the date indicated in the title. The *Education Index* should be consulted to bring these lists up to date.

Several important serial bibliographies appear either annually or at intervals. Webb's "High School Science Library" has appeared monthly in the *Peabody Journal of Education* since 1925. The initial bibliography covered the period from 1910 to 1924. Subsequent issues have listed all previous "Libraries" and the available reprints. "Science Reading Materials for Pupils and Teachers," is offered by Pruitt, at intervals, in *Science Education.* Since 1933 Beauchamp has given an annual list of annotated selected references in secondary school science in the February issue of the *School Review.* This last bibliography is to be found later in *Selected References in Education.* Pieper has a series of bibliographies concerned with research studies in the teaching of science which appear at intervals in *Science Education,* and Curtis' [5] three volumes of digests of investigations are also a valuable source of bibliography in this field. The United States Office of Education has since 1928 published annually *"Bibliography of Research Studies in Education."* This and other bibliographies of that office are treated in the discussions under Public Documents in this article.

The American Association for the Advancement of Science, with the cooperation of the American Library Association, published in 1934 twenty-seven *Science Booklists* on all phases of science for the layman, student, and teacher. Number 27 of this series deals with the "Teaching of Science." In 1938 the American Library Association published fourteen *Science Booklists for Boys and Girls,* the last of which lists sci-

[1] Curtis, Francis D. *A Digest of Investigations in the Teaching of Science in the Elementary and Secondary Schools.* Philadelphia: P. Blakiston's Sons and Company, 1926. 341 p.
—— *Second Digest of Investigations in the Teaching of Science in the Elementary and Secondary Schools.* Philadelphia: P. Blakiston's Sons and Company, 1931. 421 p.
—— *Third Digest of Investigations in the Teaching of Science in the Elementary and Secondary Schools.* Philadelphia: P. Blakiston's Sons and Company, 1939. 419 p.

[2] Deering, Clara E. "Lists and Abstracts of Masters' and Doctors' Dissertations in Education." *Teachers College Record* 34: 490–502; March, 1933.

[3] Witmer, Eleanor M., and Miller, Margaret C. "Guides to Educational Literature in Periodicals, Indexes, Abstracts, Bibliographies." *Teachers College Record* 33: 719–30; May, 1932.

[4] Monroe, Walter S., and Shores, Louis. *Bibliographies and Summaries in Education to 1935.* New York: The H. W. Wilson Company, 1936. 470 p.

[5] Curtis, *op. cit.,* Vols. I, II, III.

ence fiction. In 1940, a joint committee of the American Medical Association and the American Library Association prepared a series of nine booklists on such subjects as health, foods, and diseases. The *Booklist,* published semi-monthly (except August) by the American Library Association, gives a classified selected list of popular science books. *Science News Letter,* published weekly by Science Service, has in each issue annotated "First Glances at the New Books." One issue in April and another in October contain the semi-annual list of current books in various scientific fields, published or to be published in that half of the year. Revisions of standard works are included, as are secondary school textbooks, books on science education, popular science, monographs, reports and yearbooks.

Mudge [6] should be consulted for sources of bibliographies in the sciences, while Witmer and Miller [7] is best for other sources in the periodical literature.

BOOK REVIEWS

Signed book reviews appear in each issue of *Science Education* on all phases of the literature, including popular books, dissertations and textbooks. *School Science and Mathematics* has excellent book reviews of a similar nature. The book review section of the Sunday edition of the *New York Times* is an outstanding source of reviews on immediately recent books on science, especially if of a popular nature. These can be located through the *New York Times Index.* The *Book Review Digest* in which the listing is by author and by subject has extracts of reviews of popular science books, addresses, essays, lectures, and juvenile literature. *Subscription Books Bulletin,* published since 1930 by the American Library Assocation, has excellent reviews of reference books. The *Education Index* indicates the location of reviews by author only, and this necessitates the use of the *Cumulative Book Index* first to obtain the author's name, if it is not known.

EDITORIALS AND NEWS NOTES

Editorials are inclined to be infrequent and scattered. However *Science Education* has a department of "Editorials and Educational News," and editorials appear at intervals in *School Science and Mathematics. Scientific American* has an editorial page which concerns itself with technical developments.

Science news coverage in the public press has increased steadily in accuracy and in popular interest under the influence of the *National Association of Science Writers,* composed of about forty men who specialize in science writing. As a result, current happenings in the science fields are reliably reported in many of the larger papers of the country. Weekly news periodicals, such as *Time* and *News Week,* have well written but brief accounts of the more spectacular events which occur. Leichtman [8] investigated a large number of periodicals for their science news coverage and concluded that *Science News Letter* was the leading publication in the field of general science.

EDUCATIONAL ASSOCIATIONS

Part IV of the *Educational Directory,* issued annually as Bulletin No. 1 of the United States Office of Education, lists educational associations of the United States, giving the address of the secretary and the president, meeting dates, and their publications. Among those concerned with General Science are the American Science Teachers Association, Central Association of Science and Mathematics Teachers, National Association for Research in Science

[6] Mudge, Gilbert I. *Guide to Reference Books.* Chicago: American Library Association, 1936. 504 p. And supplement *Reference Books of 1935–1937.* 1939. 69 p.

[7] Witmer, E. M., and Miller, M. C., *op. cit.,* pp. 729–30.

[8] Leichtman, Alfred W. "News Notes for Natural Science Teachers." *School Science and Mathematics* 36: 289–92; March, 1936.

Teaching, Department of Science Instruction of the National Education Association, and the Science Association of the Middle States.

HEADINGS FOR SEARCHING

To a large extent success in searching through indexes depends upon the proper use of headings. Working time can be reduced and a more efficient coverage of the sources is assured if the searcher considers in advance under which headings the references he seeks are more likely to appear. Indexes and guides differ in the manner in which science materials are listed, and it is necessary for the student to familiarize himself with these individually. Typical headings and sub-headings illustrating the categories into which the literature of science education may be divided, follow:

Junior High Schools
Rural Schools
Science
  Achievements, student
  Aims and objectives
  Bibliography
  Correlation with other subjects
  Courses of study
  Curriculum
  Diagnosis
  Examinations, questions, etc.
  Exhibits
  Experiments
  History
  Laboratory manuals
  Projects
  Psychology
  Research
  Study
  Subject matter
  Teachers' manuals
  Teaching
    —bibliography
    —England
  Teaching aids and devices
  Teaching methods
  Terminology
  Tests and scales
  Textbooks
    —bibliography
  Units of work
  Value
  Workbooks
Secondary Schools
Science and Religion
Science Associations
Science Clubs
Science Laboratories
  Equipment and supplies
  High schools
Science Libraries
Science Masters Association
Science Rooms
Science Teachers
  American Science Teachers Association
  Physics teachers
  Training
Scientific Attitude
  Tests and scales
Scientific Education
Scientific Literature
Scientific Method
Scientific Research
  Sweden
  Canada
Scientists

HISTORY OF SCIENCE AND OF SCIENCE EDUCATION

Of the many short histories of science available, Dampier,[9] and Sedgwick and Tyler[10] are excellent, while Sarton[11] presents an exhaustive treatment. Until 1939 the *World Almanac* has had a section devoted to the scientific progress of the previous year. This was omitted from the 1940 issue and will not be resumed before 1942.

The history of science education is more difficult to locate. The most complete treatment is an unpublished dissertation by Fay.[12] Brief accounts are to be found in textbooks by Brownell[13] (Chap, 19, 20, 21, 22), Hunter[14] (Chap, 2), and Preston[15]

[9] Dampier-Wetham, W. C. D. *A History of science.* New York: The Macmillan Company, rev. 1929. 514 p.

[10] Sedgwick, W. T., and Tyler, H. W. *A Short History of Science.* New York: The Macmillan Company, rev. 1939. 512 p.

[11] Sarton, George. *Introduction to the History of Science.* Baltimore: Williams and Wilkins Co., 1927, Vol. I, 839 p.; 1931, Vol. II, 1215 p.

[12] Fay, Paul Johnson. *The History of Science Teaching in American High Schools.* Unpublished Doctor's Dissertation, Ohio State University, 1930.

[13] Brownell, Herbert, and Wade, Frank B. *The Teaching of Science and the Science Teacher.* New York: The Century Company, 1925. 322 p.

[14] Hunter, George W. *Science Teaching at the Junior and Senior High School Levels.* New York: American Book Company, 1934. 552 p.

[15] Preston, Carleton E. *The High School*

(p. 19–40). Recent articles may be located in the *Education Index,* and investigations into the history of science teaching may be located through Pieper's bibliographies. (See Bibliographies and Booklists.)

INDEXES, GUIDES AND DIRECTORIES

Of the several indexes to the periodical literature the most valuable for the science teacher is the *Education Index,* the first issue of which appeared in January, 1929. It took over much of the educational listing of other indexes which had done it up to that time. It is issued monthly, except in July and August, and provides many services. All educational books, including college textbooks, are listed, but not elementary or secondary textbooks. Booklists and book reviews appear under those heads, while in the front of the paper copies is to be found a list of the periodicals indexed, courses of study, meeting dates of educational associations, new books on education, recent public documents, and publishers' addresses. Portraits may be located by the symbol (por) after an author's name. The *Ohio File,* a card catalogue to be found only at the Ohio State University and at Teachers College, Columbia University, supplements the *Education Index* at present and extends its listing back to 1920.

The *Agricultural Index* (monthly except December) was started in 1916 and is especially valuable for articles concerned with rural science education, experiment station literature, and publications of the United States Department of Agriculture, as well as the extension divisions of the State Universities.

The *International Index,* published six times a year since 1913, is good for articles on pure science. Prior to 1929 it covered educational research, but this was taken over by the *Education Index* in January of that year.

Public Affairs Information Service, weekly since 1915, is best for recent government publications, directories, monographs and bulletins. The *Readers Guide to Periodical Literature* has listed articles of a popular or general science nature since 1900. Before the advent of the *Education Index,* it also listed many educational articles.

The *Vertical File Service Monthly,* 1932 to date, is valuable for locating pamphlets, leaflets and mimeographed materials which are free or distributed at low cost. About six thousand are catalogued, described and classified in the annual cumulation.

For further information about the indexes to the periodical literature consult Witmer and Miller.[16]

The most complete list of the books published in the United States from 1898 to 1928 is to be found in the *United States Catalogue. The Cumulative Book Index* and the *Publishers Weekly* may be used to bring a list up to date. Mudge[17] should be consulted for further information on tracing books.

For names, addresses, professional status or biographical materials about workers in the fields of science or science education, see *American Men of Science,*[18] and *Patterson's American Educational Directory.* Information regarding other important directories and cyclopedias is to be found in Alexander's textbook *How to Locate Educational Information and Data*[19] (pages 230–42).

Portraits of educators may be seen in *Who's Who in American Education,* and the location of others is indicated by the symbol (por) in the *New York Times Index, Education Index,* and the *Readers Guide to Periodical Literature.* Advertising circulars and adoptions sent out by text-

Science Teacher and His Work. New York: McGraw-Hill Book Company, Inc., 1936. 272 p.

[16] Witmer, E. M., and Miller, M. C., *op. cit.,* pp. 719–25.

[17] Mudge, *op. cit.*

[18] Cattell, J. McKeen, and Catell, Jacques. *American Men of Science.* New York: The Science Press, 1938, sixth ed. 1608 p.

[19] Alexander, Carter. *How to Locate Educational Information and Data.* New York: Bureau of Publications, Teachers College, Columbia University, 1935. 272 p.

book publishers and kept on file by education libraries are a good source of author portraits. Pictures and illustrations of value in teaching may be found in many of the current periodicals such as *National Geographic, Natural History, Nature Magazine,* and *Life.* The best available indexes are Ellis,[20] Shepard,[21] and the *Standard Catalogue for High School Libraries.*

The *Educational Directory,* Part IV (see Educational Associations) is valuable for locating those organizations interested in science education, while the *Handbook of Scientific and Technical Societies* [22] provides information regarding those devoted to pure science, many of which offer publications of value to teachers.

PERIODICALS

Periodicals of interest and of value in the teaching of General Science appear by the dozen. Of these *National Geographic, Natural History, Nature Magazine, Popular Science, Science Digest, Scientific American, Scientific Monthly,* and *Science News Letter* are outstanding. Ulrich [23] lists many more under such headings as Astronomy, Photography, or Radio.

In the field of science education the numbers are fewer. *Science Education,* the official organ of the National Association for Research in Science Teaching, offers articles on all levels of science education, classroom notes, digests of unpublished investigations, editorials and educational news, abstracts, book reviews, demonstrations, visual aid outlines, and suggestions for assembly programs. Formerly known as the *General Science Quarterly,* it is now published seven times a year and is indexed in *Education Abstracts, Education Index,* and the *Psychological Index.*

School Science and Mathematics, published since 1901, has monthly issues from October to June. It is the official organ of the Central Association of Science and Mathematics Teachers, and it offers editorials, articles on science and mathematics, experiments and materials for classroom use, convention news, science question department, book reviews, and lists of books and pamphlets received. It is indexed in *Chemical Abstracts, Education Abstracts,* and the *Education Index.*

Other periodicals of value are the *Science Teacher,* the *Journal of Chemical Education,* the *American Physics Teacher,* and the *American Biology Teacher.* For student use the *Science Observer* and *Current Science* are outstanding.

PUBLIC DOCUMENTS: FEDERAL, STATE AND LOCAL

The public documents of the United States Government have been indexed from 1774 to date, and great numbers of them are of value to teachers of General Science. The *Monthly Catalogue* of United States Public Documents, indexed annually in June, covers the period 1895 to date, and the free *Weekly List of Selected United States Government Publications* describes many of the recent issues. Over seventy free *Price Lists* of available Government documents are issued. The list for Education is Number 31, but many of the others are of value in General Science. A complete set of price lists may be obtained from the Superintendent of Documents, Washington, D. C. For exhaustive work

[20] Ellis, J. C. *General Index to Illustrations.* Boston: F. W. Faxon Company, 1931. 467 p.
—— *Nature Index.* Boston: F. W. Faxon, 1930. 319 p.

[21] Shepard, Frederick J. *Index to Illustrations.* Chicago: American Library Association, 1924. 89 p.

[22] *Handbook of Scientific and Technical Societies and Institutions of the United States and Canada.* Bulletin of the National Research Council No. 101. Washington: National Academy of Sciences, 1937. 277 p.

[23] Ulrich, Carolyn F. *Periodicals Directory.* New York: R. R. Bowker Company, rev. ed. 1938. 465 p.

with government documents Boyd [24] or Wyer [25] should be consulted.

The United States Office of Education issues most of the documents pertaining to education. Bulletin 1910, Number 3, lists all of the publications of the office from 1867 to 1910, while Bulletin 1937, Number 22, continues this list to 1936. The *Education Index* may be consulted to bring this up to date. *School Life*, the official monthly organ of the Office of Education, has two departments of value in locating documents, namely, "New Government Aids for Teachers" and "Current Publications of the Office of Education." From time to time publications of special interest to science teachers are issued by the Office, such as "Bibliography of Science Teaching in Secondary Schools" [26] and "Government Publications of Use to Teachers of Geography and Science." [27] Similar publications can be located in the *Education Index* or in *Price List* Number 31. Witmer and Miller [28] provide the best source of complete information on all publications of the Office of Education.

Public Affairs Information Service lists most of the important issues of state documents since 1915, and the *Education Index* does the same from 1928, with the additional service of a "Check List of Recent Federal and State Documents" in the front of the paper copies. In the cumulations, these appear under the name of the state. The Library of Congress has published since 1910 a *Monthly Check List of State Publications* which is cumulated with full index annually.

There are no general indexes for local documents, which are issued in great numbers. Direct communication with the proper city officials is perhaps the best way to locate such documents, but Wyer [29] suggests available lists and references.

RESEARCH IN SCIENCE EDUCATION

Of first importance in this field are Curtis' [30] three volumes of digests of investigations in the teaching of science, and Pieper's serial bibliographies (see Bibliographies and Booklists) in which hundreds of investigations relating to science teaching are listed. The annual *Bibliography of Research Studies in Education*, published since 1928 by the United States Office of Education, lists researches from institutions in all parts of the United States, including many unpublished studies. Those which have been collected in Washington are available for loan. *School Life* includes in each issue "a list of the most recently received doctors' and masters' theses in education, which may be borrowed from the Library of the Office of Education on interlibrary loan."

For locating published researches, the *Education Index* and the *Ohio File* should be consulted. Witmer [31] provides further information for finding sources of completed researches and suggests others for those underway and needed, and Deering [32] indicates the location of lists and abstracts of theses and dissertations. The December 1939 issue of the *Review of Educational Research* lists valuable bibliographic aids in methods of educational research, and the *Journal of Educational Research* carries

[24] Boyd, Anne Morris. *United States Government Publications.* New York: The H. W. Wilson Company, 1931. 329 p.

[25] Wyer, James I. *United States Government Documents.* Chicago: American Library Association, 1933. 56 p.

[26] Glenn, E. R., and Walker, Josephine. *Bibliography of Science Teaching in Secondary Schools.* United States Bureau of Education Bulletin, 1925, No. 13. Washington: Government Printing Office, 1925. 161 p.

[27] United States Office of Education. *Government Publications of Use to Teachers of Geography and Science.* Leaflet No. 31. Washington: Government Printing Office, 1938. 16 p.

[28] Witmer, Eleanor, and Miller, Margaret. "United States Office of Education Serial Publications." *Teachers College Record* 34: 302–11; January, 1933.

[29] Wyer, *op. cit.*, pp. 45–49.

[30] Curtis, *op. cit.*, Vols. I, II, III.

[31] Witmer, Eleanor M. "Educational Research. A bibliography of sources useful in determining research completed or under way." *Teachers College Record* 33: 335–40; January, 1932.

[32] Deering, Clara E., *op. cit.*

research articles, reviews, abstracts, bibliographies and news.

In the January issue of the latter journal, Good lists annually the educational research which is under way in the institutions of the country. The list is classified and includes the name of the student, sponsor, and the subject of investigation.

Jessen [33] has analyzed trends with respect to future researches in science education and has indicated three definite lines along which needed research in this field might well proceed, and the New York State Education Department has issued annually since 1932 *Needed Educational Research in New York State.*

REFERENCE BOOKS

The *Thirty-First Year Book* [34] of the National Society for the Study of Education is a landmark in the literature of science education and has exercised great influence since its publication in 1932. More recently, *Science in General Education,*[35] the report of the Committee on Secondary School Curriculum, is effecting science teaching.

Heiss [36] presents fine materials and methods for science teaching, as does Woodring,[37] although the only available edition of the latter is rather out of date. Excellent textbooks on the teaching of science have been written by Frank,[38] Preston,[39] Noll,[40] and Hunter.[41] Of great value to the teacher in search of experiments are the two volumes by Adlam,[42] and others by Miller and Blaydes,[43] Sutton,[44] and Fowles.[45] For general references in science, the leading encyclopedia is the *Britannica,* and especially valuable are the reprints [46] in the field of sciences which are sold at moderate cost. The *World Almanac* carries considerable miscellaneous information, and *Van Nostrand's Scientific Encyclopedia* [47] has been pronounced the best available.

Of general interest and purchasable in the less expensive editions are: *The Nature of the World and of Man,*[48] *The Science*

[33] Jessen, Carl A. *Needed Research in Secondary Education.* United States Office of Education Bulletin, 1937, No. 28, pp. 56–59. Washington: Government Printing Office, 1938.

[34] National Society for the Study of Education. Report of the Committee on the Teaching of Science. Thirty-First Yearbook, *Part I, A Program for Teaching Science.* Bloomington: Public School Publishing Company, 1932. 370 p.

[35] Thayer, V. T., and Others. *Science in General Education.* New York: D. Appleton-Century Co., Inc., 1938. 591 p.

[36] Heiss, Elwood D., Ellsworth, S. Obourn, and Hoffman, C. Wesley. *Modern Methods and Materials for Teaching Science.* New York: The Macmillan Company, 1940. 351 p.

[37] Woodring, Maxie Nave, Oakes, Mervin E., and Brown, H. Emmett. *Enriched Teaching of Science in the High School.* New York: Bureau of Publications, Teachers College, Columbia University, 1928. 374 p.

[38] Frank, Joseph Otto. *How to Teach General Science.* Philadelphia: P. Blakiston's Sons and Company, 1926. 240 p.

[39] Preston, *op. cit.*

[40] Noll, Victor Herbert. *Teaching of Science in Elementary and Secondary Schools.* New York: Longmans, Green and Company, 1939. 238 p.

[41] Hunter, *op. cit.*

[42] Adlam, G. D. J., ed. *The Science Masters' Book. Part I, Physics,* 273 p. *Part II, Chemistry and Biology,* 255 p. London: John Murray, publisher, 1931.

[43] Miller, David F., and Blaydes, Glenn W. *Methods and Materials for Teaching Biological Sciences.* New York: McGraw-Hill Company, Inc., 1938. 435 p.

[44] Sutton, Richard Manliffe. *Demonstration Experiments in Physics.* New York: McGraw-Hill Company, Inc., 1938. 545 p.

[45] Fowles, G. *Lecture Experiments in Chemistry.* Philadelphia: P. Blakiston's Sons and Company, 1937. 564 p.

[46] Huxley, Julian S., supervising editor. Britannica Booklets. *Mammals and Birds,* Booklet No. 3, 1933, 199 p. *Botany, the Science,* Booklet No. 10, 1933, 200 p. *Botany: Plants and Gardening,* Booklet No. 9, 1933, 239 p. *The Earth, the Seas and the Heavens,* Booklet No. 5, 1933, 236 p. *Fishes, Reptiles and Insects, Booklet* No. 8, 1933, 265 p. New York: Encyclopedia Britannica, Inc.

[47] *VanNostrand's Scientific Encyclopedia.* New York: D. VanNostrand Company, 1938. 1234 p.

[48] Newman, H. H., ed. *The Nature of the World and of Man.* Garden City: Garden City Publishing Company, Inc., 1933. 562 p.

of Life,[49] *The Outline of Science,*[50] and *Science for the Citizen.*[51] Student reference books of value include the *World Book,* which has an annual looseleaf supplement, *Compton's Pictured Encyclopedia,* and the *Junior Britannica.*

For further reference books of value in science teaching consult bibliographies by Webb and Pruitt. (See Bibliographies and Booklists.) For basic reference books in the sciences see Shores[52] and Mudge.[53]

TEXTBOOKS AND PUBLISHERS

The bibliographies by Webb and Pruitt mentioned above are also of immense value in the location of textbooks and are additionally helpful in that names and addresses of publishers are provided. The *American Education Catalogue* has listed textbooks from 1872 to date, but these lists are not always complete. *School Science and Mathematics* lists "Books and Pamphlets Received," and *Science News Letter* is a valuable index for new and revised editions. An exhaustive list from 1898 to date may be obtained by using a combination of the *United States Catalogue,* the *Cumulative Book Index,* and the *Publishers Weekly.* The Society for Curriculum Study issues *News Bulletins* in which textbooks are listed with brief annotations and are classified according to subject. The addresses of book publishers may also be found in the *Education Index* and in the *Cumulative Book Index.*

Adoptions issued by publishing houses will indicate the extent of use of a given textbook and aid in its evaluation. Bray[54] has provided a score card useful in the evaluation of science textbooks.

[49] Wells, H. G., Huxley, Julian S., and Wells, G. P. *The Science of Life.* New York: The Literary Guild, 1934. 1514 p.

[50] Thomson, J. Arthur. *The Outline of Science.* New York: G. P. Putnam's Sons, 1937. 1220 p.

[51] Hogben, Lancelot. *Science for the Citizen.* New York: Alfred A. Knopf, 1938. 1082 p.

[52] Shores, Louis. *Basic Reference Books.* Chicago: American Library Association, 1939, second ed. 472 p.

[53] Mudge, *op. cit.*

[54] Bray, Willis J. "Selection of High School Science Textbooks." *Science Education* 18: 147–51; October, 1934.

SIX YEARS OF HAWK PROTECTION

ROSALIE EDGE
President, Hawk Mountain Sanctuary Association, Drehersville, Pennsylvania

A hundred thousand hawks and eagles have migrated over Hawk Mountain Sanctuary, have been counted, identified and recorded by the Curator, Mr. Maurice Broun, since the Sanctuary was established in the autumn of 1934. There is no place where hawks can be observed in such numbers as at this Sanctuary at Drehersville, Pennsylvania. Here bird students, scientific ornithologists and erstwhile hawk-shooters sit together in amiable companionship on the Observation Rocks, watching the flights during the months of September, October and November. Here it was, in years past, that gunners gathered to shoot the hawks for no better reason than that they enjoyed the exercise of their marksmanship. Great was the outcry from the gunners when I first leased and then bought two square miles of wooded mountain top, and stopped the shooting. Now the Sanctuary, owned and operated by the Hawk Mountain Sanctuary Association, incorporated in Pennsylvania, is in the full swing of its seventh season, and old enmities are forgotten among the crowd of visitors that spend happy hours and days watching the birds, and enjoying the glowing colors of the panoramic view from the summit.

Eighteen species of raptores have been observed from Hawk Mountain Sanctuary, including both the White Gyrfalcon (1 specimen) and the Black Gyrfalcon (3 specimens). The great "find" on this migration route has been the Golden Eagle. Before scientific observations were made at Hawk Mountain Sanctuary, it was generally supposed that no Golden Eagles bred on the eastern seaboard, and that the Golden Eagles occasionally seen in the Alleghanies were wanderers from the West. But from Hawk Mountain Sanctuary a procession of migrating Goldens are seen year by year, late in the autumn, both adults and immatures; and students are now intrigued to discover where these birds nest. Many other facts have been learned. For instance, we now know something of the proportion of one species of raptore to another. How pitifully few Bald Eagles there are; but in happy contrast, how many Red-tails and Broad-wings, hawks most valuable to the farmer.

Mr. Broun has correlated hawk flights and weather conditions during six seasons, and is able to give some sage advice as to when it is best to visit the Sanctuary. The birds are seen in greatest numbers one or two days after a low pressure area in the North. September is the time especially for Broad-wings and Bald Eagles. The greatest number of species fly during the crisp days of October; it is then that the great flights of Red-tails come over. November brings the Golden Eagles, together with the last of the Red-tails and other species.

Table I gives some figures prepared by Mr. Broun for the years 1934 to 1939, inclusive.

TABLE I

HAWK MIGRATIONS—TABLE OF SEASONAL TOTALS

Species	1934	1935	1936	1937	1938	1939
Turkey Vulture	166	374	87	44	60	146
Eastern Goshawk	123	293	177	49	9	26
Sharp-shinned Hawk	1,913	4,237	4,486	4,817	3,113	8,529
Cooper's Hawk	333	553	474	492	204	590
Eastern Red-tailed Hawk	5,609	4,024	3,177	4,978	2,230	6,496
Northern Red-shouldered Hawk	90	181	153	163	143	314
Broad-winged Hawk	2,026	5,459	7,509	4,500	10,761	5,736
American Rough-legged Hawk	20	9	9	4	.....	8
American Golden Eagle	39	66	54	73	31	83
Bald Eagle	52	67	70	38	37	64
Marsh Hawk	105	153	149	160	189	273
Osprey	31	169	205	201	124	174
White Gyrfalcon	2	.....	.....	.....	.....	.....
Black Gyrfalcon	2	.....	1	.....	.....	.....
Duck Hawk	25	14	36	41	24	38
Pigeon Hawk	19	20	34	10	12	43
Eastern Sparrow Hawk	13	123	102	141	87	184
Unidentified	208	23	11	8	.....	.....
Totals	10,776	15,765	16,734	15,719	17,024	22,704

Hawk Mountain Sanctuary is best approached by Route 22 (New York to Harrisburg), turning off on Route 142 at Lenhartsville, between Hamburg and Allentown. As one nears the Sanctuary from whatever direction the roads are clearly marked by Sanctuary signs. A good mountain road, newly repaired, leads to the Sanctuary entrance. Visitors are cordially welcomed. Pleasant lodgings and good board may be obtained at nearby farms. All requests for information should be addressed to: Maurice Broun, Curator; Hawk Mountain Sanctuary, Route 1, Orwigsburg, Pennsylvania.

Editorials and Educational News

THE CLINIC IDEA IN SCIENCE

The clinic or clinical conference is a device which may be used by teachers and administrators in order that they may become acquainted with problems encountered in any field of education, and possible solutions for the same.

This device is equally valuable in a large or small school system. In a large system where it is practically impossible for the supervisor to personally visit each science department as often as he should, it enables him to be familiar with problems that would otherwise escape his notice.

The clinic idea is based on the assumption that if a medical clinic is a place where people with physical problems may go, present their problems and with the help of a group of experts, solve them or, at least, approach their solution, then a science (or any other field) clinic should be a place where science teachers may go, present problems encountered in the teaching of science and with the help of a group of experts, in this case teachers themselves, solve these problems or approach their solution. A clinical group should be kept under thirty members, otherwise it becomes unwieldy and defeats the purpose of the conference. In a large system one teacher from each school is sufficient.

At the start of a clinical conference, the leader (who may be the supervisor) explains the "clinic" idea. He urges them to refrain from speeches and debates while participating, in order to conserve time.

Following is a brief account of a clinic held in general science:

After a brief introduction the members of the group were invited to present their problems, one at a time, which were listed on the board. When all problems were listed, problems of a similar nature were grouped together, thus cutting down the number. Then the problems were thrown back to the group, one at a time, by the leader for solution. In other words, the collective thinking of a group of teachers of the subject was used to help solve the problems of the group. In most cases, when a problem was presented, there were several worthy solutions suggested by members of the group. It seemed as though each problem had been encountered by many and solved by at least a few. The solutions were also written down on the board opposite the statement of the problem so that members of the group could follow developments. Any problems remaining unsolved were turned over to a committee from within the group for study and possible solution, the findings of this committee to be made known to the remainder of the group on completion of the study.

Among the problems presented at a General Science Clinic were:

1. Insufficient equipment.
2. Feasibility of general science and mathematics sharing time.
3. What to evaluate and how to do it?
4. Use of visual aids.
5. Value of field trips.
6. Should workbooks be used?
7. Can general science be successfully correlated with other subjects?
8. How can we interest the low ability, slow-reader or under-privileged child in science?

Teachers who have participated in these clinics to date acclaim them as the most valuable and helpful type of conference in which they have taken part.

PAUL F. DEVINE,
Supervisor of Mathematics and Science,
Los Angeles City Schools

NEW PRACTICES IN HIGH SCHOOLS

The October 1940 issue of *The Bulletin of the National Association of Secondary-School Principals* is a manual of 226 pages which contains "descriptions of numerous approaches used by secondary-school principals to the problem of developing ways and means of improving secondary education, and giving information on what these reporting principals consider promising practices in their schools."

The manual contains short reports from hundreds of principals and superintendents from all sections of the country. A number of these individual reports pertain to promising practices in secondary-school science. Every science teacher will profit in his philosophy of science teaching by scanning this Bulletin.

THE WORLD AT WORK

A series of pamphlets which should prove to be of value to science teachers as well as to teachers of social studies is being prepared by the National Youth Administration of the Federal Security Agency under the supervision of Charles H. Judd, Educational Consultant, with the cooperation of the General Electric Company, the Rural Electrification Administration, and the National Bureau of Standards. The purpose of the series "is to supply information about some of the services which Government renders for the people of the United States, about the way in which invention has stimulated the development of some of the great industries of the country, and about ways in which the young men and young women of America can participate in productive work that will be of profit to themselves and to the Nation."

To date the following pamphlets, available from the Superintendent of Documents, Washington, D. C., at fifteen cents each, have been published:

Number	Title
1	Electricity
2	Standards
3	Agriculture
4	Roads
5	Automobiles
6	Weather

The booklets are unusually well illustrated with large cuts and are printed in a format which makes reading easy. It seems evident that a large number of publications in this series should add very worthwhile material for pupils in science classes at the elementary and secondary school levels and for adults. It is material of this kind which will aid our pupils and citizens to recognize more clearly the civic and social significance of science in modern living. May we express the hope that the series will be a long one, and that later pamphlets will be as valuable as those which it has been our pleasure to examine.

CONSERVATION UNITS

The Emergency Conservation Committee, of which Mrs. C. N. Edge is chairman, has published six units dealing with various phases of conservation. The titles of these units are as follows: (1) "Shortage of Waterfowl", (2) "Hawks", (3) "Two Eagles of North America", (4) "Fish-Eating Birds", (5) "Owls", (6) "Our Nation's Forests."

These units appear to be of particular value for biology teachers, containing specific suggestions for the teacher. They are sold at ten cents a copy.

In addition to these purchasable publications the Committee has issued several free publications on various phases of conservation some of which will be usable by teachers of science and also by high-school students. The address of the Committee is 734 Lexington Avenue, New York, N. Y.

AMATEUR SCIENTISTS' ORGANIZATIONS

Teachers of science will find of considerable interest a new directory of amateur scientists' organizations and resources in science, published under the title, *The Layman Scientist in Philadelphia.* The booklet of 44 pages was prepared by the Committee on Education and Participation in Science of the American Philosophical Society.

Following a brief introduction on the scope of the listings there appears a detailed directory of each of the amateur clubs and societies in the vicinity of Philadelphia classified under various science fields. Included in the information for each of the societies is a statement of purpose, the date on which the organization was founded, the major activities of the society, reference to its publications, and present officers.

Another part of the pamphlet lists the various educational opportunities in science for adults in the neighborhood of Philadelphia including courses, lectures, demonstrations, field trips, and exhibits.

We are prompted to wish that similar directories for other cities in the country might be available. The directory may be obtained at a cost of fifteen cents from the American Philosophical Society, 104 South 5th Street, Philadelphia, Pa.

P. E. A. CONFERENCE

The Progressive Education Association has scheduled a conference for November 29–30 to discuss the pertinent topic "Education for National Defense." The meeting will be held at Hotel Pennsylvania in New York City.

The array of speakers and discussants is a highly representative group of educators and leaders in American thought. Topics for the various group conferences include "Critics of the New Education and the Task Ahead," "Education in Times of a Crisis," "Meeting the Attacks on Education," and "Education and National Defense."

MOTION PICTURE LISTS

Two especially helpful lists of available motion pictures have come to our desk recently. The first is a pamphlet prepared by the Bureau of Mines describing 28 silent films of 16 mm. and 35 mm. width, relating to topics of direct interest to science teachers, and presenting detailed information concerning procedures in borrowing the films. Films described include, among others, the following: "The Story of Asbestos," "Water Power," "The Story of Gasoline," "Through Oil Lands of Europe and Africa," "Carbon Monoxide: The Unseen Danger," "From Mountain to Cement Sack," and "Making a *V*-type Engine." The list may be obtained from the Bureau of Mines Experimentation, 4800 Forbes Street, Pittsburgh, Pa.

The second is a mimeographed booklet distributed by the Photographic Section of the Division of Information, U. S. Department of the Interior, Washington, D. C. Eighty-nine films are listed with brief annotations. Many of these are of a science interest. A few of the titles are: "Alaska Fur Seals," "Boulder Dam," "Fish, From Hatchery to Creel," "Game Bird Farming," "Know Your Coal," "Reclamation in the Arid West," and "Sugar." Not all of these films are new. Rules and regulations for borrowing the films are given.

Enriching Science Teaching

Visual Aids

American Brass Company, Waterbury, Connecticut. 16 mm., sound film. (Rental)
The House of Dreams

Bell and Howell, 1801 Larchmont Ave., Chicago, Ill. 16 mm., silent and sound film. (Rental or Purchase)
Elephant, Devil or God? (Contrast between African and Indian elephants)

Chicago Tribune, Tribune Tower, Chicago, Ill. 16 and 35 mm., sound film.
Trees to Tribunes

Eastman Teaching Films, Inc., Rochester, N. Y. 16 mm., silent film. (Purchase)
Circulatory Control

Erpi Classroom Films Inc., 35–11 35th Ave., Long Island City, N. Y. 16 mm., sound films. (Purchase)
Tuberculosis, Its Diagnosis, Treatment and Control
Safety in the Home
Work of the Kidneys
Endocrine Glands

Field Museum of Natural History, Grant Park, Chicago, Ill. *The Story of Food Plants.* Bulletin No. 25 (Pictures telling story of food plant history). 1940. 25 cents.

Lockwedge Shoe Corporation of America, Inc., Columbus, Ohio. 16 mm., sound film. (Rental)
The Lady Walks (Shoes and posture)

Metropolitan Life Insurance Company, New York City. 35 mm., silent filmstrips to accompany Health Heroes Series. (Rental)

Rutgers Films, Rutgers University, New Brunswick, N. J. 16 mm., silent film. (Rental or Purchase)
Animal Life in the Antarctic

United States National Museum, Division of Graphic Arts, Washington, D. C. *How Prints Are Made.* (Exhibits on etching, rotogravure and other processes—may be borrowed. Write the Museum for information.)

Veragraph Film Corporation, 145 West 45th Street, New York City. 16 mm., sound and silent film. (Rental)
I Conquer the Sea (Whaling Industry)

Williams, Brown and Earle, Philadelphia, Pa. 16 mm., silent film. (Rental, $1.00)
Plants without Soil

Science Pamphlets and Bulletins

A. U. S. Government

American Hardwood. Bureau of Foreign and Domestic Commerce, Trade Promotion Series No. 201. Superintendent of Documents, Washington, D. C. 1940. 10 cents.

American Southern Cypress. Bureau of Foreign and Domestic Commerce, Trade Promotion Series No. 194. Superintendent of Documents, Washington, D. C. 1940. 10 cents.

American Southern Pine. Bureau of Foreign and Domestic Commerce, Trade Promotion Series No. 191. Superintendent of Documents, Washington, D. C. 1940. 10 cents.

Bean Growing in Northern Idaho, Eastern Washington, and Eastern Oregon. U. S. Department of Agriculture, Farmers' Bulletin No. 1509. Superintendent of Documents, Washington, D. C. 1940. 17 p. 5 cents.

Care and Management of Farm Work Horses. U. S. Department of Agriculture, Farmers' Bulletin No. 1419. Superintendent of Documents, Washington, D. C. 1940. 18 p. 5 cents.

Children in a Democracy. General Report adopted by the White House Conference. Superintendent of Documents, Washington, D. C. 1940. 86 p. 20 cents.

Development and Use of Baking Powder and Baking Chemicals. U. S. Department of Agriculture, Circular No. 138. Superintendent of Documents, Washington, D. C. 1940. 18 p. 5 cents.

Diets of Employed Workers. U. S. Department of Agriculture, Circular 507. Superintendent of Documents, Washington, D. C. 1940. 15 cents.

Electric Light for the Farmstead. U. S. Department of Agriculture, Farmers' Bulletin No. 1838. Superintendent of Documents, Washington, D. C. 1940. 62 p. 10 cents.

Electricity. The Modern World at Work, No. 1. Federal Security Agency, National Youth Administration. Superintendent of Documents, Washington, D. C. 1940. 48 p. 15 cents.

Feeding, Care and Management of Young Dairy Stock. U. S. Department of Agriculture, Farmers' Bulletin No. 1723. Superintendent of Documents, Washington, D. C. 1940. 44 p. 10 cents.

Geographical Distribution of Diphtheria Mortality in the United States. Public Health Reports, Reprint No. 2151. Superintendent of Documents, Washington, D. C. 1940. 8 p. 5 cents.

Instructions for Making Pilot Balloon Observations. U. S. Department of Agriculture, Weather Bureau Bulletin No. 1278. Superintendent of Documents, Washington, D. C. 1940. 68 p. 15 cents.

Methods and Equipment for Home Laundering. U. S. Department of Agriculture, Farmers' Bulletin No. 1497. Superintendent of Documents, Washington, D. C. 1940. 40 p. 5 cents.

Milk and Butterfat Production by Dairy Cows on Four Different Plans of Feeding. U. S. Department of Agriculture, Technical Bulletin 724. Superintendent of Documents, Washington, D. C. 1940. 36 p. 10 cents.

Occupational Poisoning in the Viscose Rayon Industry. U. S. Department of Labor, Bulletin No. 34. Superintendent of Documents, Washington, D. C. 1940. 79 p. 15 cents.

Our National Resources: Facts and Problems. National Resources Planning Board. Superintendent of Documents, Washington, D. C. 1940. 45 p. 10 cents.

The History and Development of the Fisheries of the Columbia River. U. S. Department of Interior, Bureau of Fisheries, Bulletin 32. Superintendent of Documents, Washington, D. C. 1940. 25 cents.

The Sweetpotato Weevil and How to Control It. U. S. Department of Agriculture, Leaflet No. 121. Superintendent of Documents, Washington, D. C. 1940. 8 p. 5 cents.

The Wholesale Fruit and Vegetable Markets of New York City. U. S. Department of Agriculture, Special Report. Superintendent of Documents, Washington, D. C. 1940. 123 p. 25 cents.

B. NON-GOVERNMENT

Employment in Land Transportation. By Felix B. Streyckmans. Chicago Junior Association of Commerce. Science Research Associates, 600 South Michigan Avenue, Chicago, Ill. 1940. 49 p. 50 cents.

Jobs in Horticulture. By Gilbert W. Wernicke. Science Research Associates, 600 South Michigan Avenue, Chicago, Ill. 1940. 48 p. 50 cents.

Occupations in Radio. By Kenneth G. Bartlett and Douglass W. Miller. Science Research Associates, 600 South Michigan Avenue, Chicago, Ill. 1940. 48 p. 50 cents.

The Finer Side of Life. By E. Laurence Palmer. Cornell Rural School Leaflet. Volume 34, No. 2. The New York State College of Agriculture, Cornell University, Ithaca, New York. November, 1940. 30 p.

COURSES AND UNITS OF STUDY IN SCIENCE AND RELATED FIELDS

A Course of Study in Biology. District of Columbia Public Schools, Washington, D. C. 1940. 59 p. (Mimeographed.)

Agriculture: Non Vocational Course for Grades 9 and 10. Department of Public Instruction, State of Iowa, Des Moines, Iowa. 1940. 154 p.

Alternate Course of Study in General Science for Grades 7, 8 and 9. District of Columbia Public Schools, Washington, D. C. 1940. 46 p. (Mimeographed.)

Course of Study for Elementary Grades. State Board of Education, State of Nevada, Carson City, Nevada. 1939. (See pp. 168–175 for Elementary Science.)

Course of Study for Industrial Chemistry. District of Columbia Public Schools, Washington, D. C. 1940. 4 p. (Mimeographed.)

Curriculum Content in Conservation for Elementary School. U. S. Office of Education. Superintendent of Documents, Washington, D. C. 1940. 79 p. 15 cents.

Safety Education. (Revised Edition) State Department of Public Instruction, State of Iowa, Des Moines, Iowa. 1940. 140 p.

Suggestions for the Teaching of Safety Education in the High Schools of South Carolina. By C. H. Waterfall. Department of Education, State of South Carolina, Columbia, South Carolina. 1939. 128 p.

Suggestive Course of Study for Home Economics. Grades 7–12. Saginaw Public Schools, Saginaw, Michigan. 1939. 131 p. $1.00.

PAMPHLETS FOR THE SCIENCE TEACHER

A. GENERAL EDUCATION

An Educational Program for the Youth of New York State. New York State Teachers Association, 152 Washington Avenue, Albany, N. Y. 1940. 24 p.

Criteria for the Selection and Guidance of Developmental Experiences for Children in Elementary Schools (Report of Committee). Elementary Curriculum. State of Ohio, Bulletin No. 11. State Department of Education, State of Ohio, Columbus, Ohio. 1940. 12 p.

Democracy and Education in the Current Crisis. Teachers College, Columbia University. New York: Bureau of Publications, Teachers College, Columbia University, 525 West 120th Street. 1940. 13 p. Single copies free; copies in quantities, $1.80 per 100.

Education and the Defense of American Democracy. Educational Policies Commission. By the Educational Policies Commission of the National Education Association and the American Association of School Administrators. National Education Association, 1601 Sixteenth Street, N.W., Washington, D. C. 1940. 24 p. 10 cents.

Scientific Consumer Purchasing, A Study Guide for Consumers. By Alice L. Edwards. American Association of University Women, Washington, D. C. 1939. 81 p. 60 cents.

Teachers' Guide to the Kansas Elementary School Program of Studies. Science—Part I. State Department of Public Instruction, Topeka, Kansas. 1940. 28 p.

Teaching as a Career. By Cyril O. Houle. The Department of Education, The University of Chicago. Science Research Associates, 600 South Michigan Avenue, Chicago, Ill. 1940. 50 cents.

Teaching with Motion Pictures: A Guide to Sources of Information and Materials. By Mary E. Townes. Teachers College Library Contributions, No. 1. Teachers College, Columbia University, New York, N. Y. 1940 (Revised). 30 p. 35 cents.

The Teacher Looks at Conservation. By Ollie E. Fink. Ohio Division of Conservation and National Resources, Columbus, Ohio. 1940. 64 p.

What the High Schools Ought to Teach. American Council on Education, 744 Jackson Place, Washington, D. C. 1940. 36 p. 25 cents.

B. SCIENCE EDUCATION

Pedestrian Protection. American Automobile Association, Safety and Traffic Engineering Department, Washington, D. C. 1939. 90 p. 50 cents.

Quiz on Railroads and Railroading. Association of American Railroads, Transportation Building, Washington, D. C. 1940. 58 p. Free.

Teaching Guide for the Transportation and Communication Units. By Marjorie Milburn and and John Y. Beaty. Beckley-Cardy Company, Chicago, Ill. 1940. 91 p. 50 cents.

Teacher Liability for Pupil Injuries. Safety Education Projects of the Research Division of National Education Association, 1201 Sixteenth Street, N.W., Washington, D. C. 1940. 24 p. 25 cents.

Teaching the Control of Black Stem Rust of Small Grains in Vocational Agriculture Classes. U. S. Office of Education, Vocational Division Leaflet No. 1, Superintendent of Documents, Washington, D. C. 1940. 12 p. 5 cents.

Teaching Guide for the Clothing and Shelter Units. By Marjorie Milburn and Jonathan Yale. Beckley-Cardy Company, Chicago, Ill. 1940. 123 p. 50 cents.

Teaching Vocational Agriculture: A State Program of Work in Agricultural Education of Below-College Grade. Division of Vocational Agriculture, the State Department of Education, State of South Carolina. Columbia, S. C. 1940. 11 p.

The Organization and Administration of Vocational Agriculture in Illinois. Board of Vocational Education, Bulletin No. 73. The Board, Springfield, Illinois. 1939. 68 p.

The School Garden: A Laboratory of Nature. By Van Evrie Kilpatrick. School Garden Association of New York, 121 East 51st Street, New York, N. Y. 1940. 134 p. $1.00.

Visual Aids for Pupil Adventure in the Realm of Geography. By Seymour West. New Jersey State Teachers College, Upper Montclair, New Jersey. 1940. 20 p. (Mimeographed.) 50 cents.

Visual Aids in the Realm of Chemistry. New Jersey State Teachers College, Upper Montclair, New Jersey. 1940. 11 p. (Mimeographed.) 25 cents.

Vocational Agriculture in the P. K. Yonge Laboratory School and Its Values. By M. B. Jordan. University of Florida, Bulletin No. 14. Bureau of Educational Research, University of Florida, Gainesville, Florida. 1939. 9 p.

Abstracts

Education

Symposium. "Teacher Education." *The Educational Forum* 4: 5–76; November, 1939.

Several aspects of teacher education are discussed in the following articles by the following authors: (1) Unsolved Problems in Teacher Education by Payson Smith; (2) A Century of Public Teacher Education by Roscoe L. West; (3) Henry Barnard—Educator of Teachers by Ralph C. Jenkins; (4) The Growth of American Teacher Education by Cornelius Jaorsma; (5) Educating Teachers for Guidance and Activities by Philip W. L. Cox; (6) The Teacher and the Modern World by E. J. Ashbaugh; (7) Guidance in Adulthood and Childhood by Lucinda Jennings, and (8) French Secondary Education by I. L. Kandel.

—C.M.P.

Mitchell, Wesley C. "The Public Relations of Science." *Science* 90: 599–607; December 29, 1939.

Public relations of science have recently become disturbing both to the public and to scientists. Changed social conditions have been the cause of this. There is a widespread disposition to hold science responsible for the ills men are bringing upon themselves—for technological unemployment, for the rise of autocracies, for the suppression of freedom, for the heightened horrors of war. In the present situation scientists have two sets of opportunities and responsibilities: first, their opportunities and responsibilities as citizens; second, their opportunities and responsibilities as investigators.

—C.M.P.

Dilla, Geraldine. "On Ignorants Abroad." *The Educational Forum* 4: 77–88; November, 1939.

Many American ignorants go to Europe to see —what even they themselves know not. American ignorance of language, customs, prejudices, and good taste often leads to much unpleasantness and misunderstanding. Europe offers much for the right tourist.

—C.M.P.

Bean, Charles Homer. "The Psychology of Discipline." *The Educational Forum* 4: 181–185; January, 1940.

To most people discipline means unquestioning obedience—the kind that attains in Germany and Russia. But there is another kind of discipline that should be a part of the habit structure of every American—intelligent obedience to parents, teachers, policemen, to the laws of physical and mental nature, to the justifiable traditions of family and community life, and to the will of democratic majorities.

—C.M.P.

Lawson, Douglas E. "Teachers' Marks—Tragic and Absurd." *The Educational Forum* 4: 175–179; January, 1940.

The author repeats the experiment Starch used 30 years ago—essay tests in various fields—and got the same results! Forty-one teachers of remarkably similar social and educational background took part in the experiment. The author believes that the only way out is the use of objective tests.

—C.M.P.

Symposium. "Civilization Won't Smash." *Science News Letter* 37: 42–44; January 20, 1940.

Opinions of Charles F. Kettering, Ales Hrdlicka, Franz Boas, Anton J. Carlson, William E. Ritter, Knight Dunlap, and Charles B. Davenport are quoted. In general, they all agree civilization will not be destroyed—there will be some retardation. The economic system may be greatly changed.

—C.M.P.

Anonymous. "Cousins Recently Born are Brother and Sisters." *Science News Letter* 37: 52; January 27, 1940.

Geneticists say that children with two sets of parents are brother and sisters, nevertheless, because Benjamin and Hyman Rubin, identical twins, married Sylvia and Ruth Reisman, also identical twins. Now one couple are the parents of identical twin girls, and the other couple a boy born just four days before.

The little boy is a cousin of the little girls, but genetically speaking, their brother. Since his father is identical in heredity to the father of the girls and since his mother is identical to their mother, he is exactly as closely related to them as though he had been born to the same parents. This is no play on words but is scientifically accurate. For identical twins have their origin in a single egg cell. They have drawn exactly the same set genes in the "grab-bag" of human heredity. So far as the traits they can pass on to their children are concerned, they are interchangeable.

—C.M.P.

Symposium. "The Library in the School." *The Phi Delta Kappan* 22: 281–320; February, 1940.

All of the articles in this issue are devoted to the place and use of the library in schools. There seems to be a rather definite present trend to make the school library-centered.

—C.M.P.

Emmert, Wilbur. "Models for Enrichment." *The Educational Screen* 19: 166–168; April, 1940.

Mr. Emmert, director of Visual Education in the State Teachers College at Indiana, Pennsylvania, in his department "In and for the Class-

room" describes some models easily constructed, or obtained from supply houses, useful in dealing with elementary astronomy in survey courses and the like.

O. E. Underhill.

McCOWEN, MAX C. "A Controlled Experiment in Visual Education in General Science." *The Educational Screen* 19: 143–146, 172–173; April, 1940.

Equated control and experimental groups of 7th grade General Science Students in the Indiana State Teachers College Laboratory School (Terre Haute) were taught two units in General Science. Both groups used the same study outlines, references, and procedures except that the experimental group used motion pictures and lantern slides. Detailed outlines and tests are given for the two units, "Life on the Earth" and "The Relation of the Water Supply to the Welfare of the Community." The results indicate definite gains on the part of the experimental group, with significant critical ratios.

O. E. Underhill.

NORTON, JOHN K. "Dissertations and Projects." *The Advanced School Digest* 5: 81–83; March, 1940.

This article is addressed to those students in graduate education who have had relatively little experience in conducting comprehensive researches or professional investigations and in reporting the results thereof. Practical advice is given in appraising a topic for study, appraising one's qualifications, and in certain other aspects of the research study.

—C.M.P.

HANSEN, JOHN ELMORE. "A Study of the Comparative Effectiveness of Three Methods of Using Motion Pictures in Teaching." *Educational Screen* 19: 55–98; February–March, 1940.

This is a carefully controlled study of the values derived from different ways of using films. Some of the sound Erpi classroom films and the silent Eastman films were used as the basis of the experiment. The subjects consisted of tenth grade biology classes. Ten classes were divided into three experimental groups; each taught employing a different method of presenting the film. A detailed outline of procedure used in each of the three groups is given. The same motion pictures were used in all three groups, the only difference in presentation being in the matter of the oral explanatory accompaniment and class discussion during the second showing of the films. The results seem to indicate that the formal verbal continuity which has been prepared by the producers as an integral part of the sound motion picture is more effective than the other methods. The method in which the sound continuity was shut off in both showings of the picture and teacher-pupil discussion substituted seems to be the least effective. This seems to indicate that the pupil participates more functionally by a passive listening to the well prepared teaching equipment than by the more active participation in discussion. Probably the most striking evidence furnished by this study is that the motion picture is a very valuable aid to learning regardless of the particular method used in presenting it and that although the teaching methods used do make a difference, apparently the most important fact in presenting motion pictures is a good pictorial presentation. The data in this study have been handled with adequate statistical techniques. It raises, however, as many questions as it answers and seems to provide the beginning of a type of research which may profitably be carried much further.

O. E. Underhill.

ELEMENTARY SCIENCE

ANONYMOUS. "The Albatross." *The Grade Teacher* 57: 19, 63–64; March, 1940.

This illustrated unit presents information for the teacher, questions for class work, and pupil activities.

—C.M.P.

CAGLE, FRED R. "The Turtle." *The Grade Teacher* 57: 8, 66–67; March, 1940.

This is an illustrated science unit intended for the primary grades. The unit includes suggestions for teaching, objectives, class activities, facts, and suggestive questions.

—C.M.P.

ERPENSTEIN, O. M. "A Pole Bean Grows." *The Grade Teacher* 57: 18–19, 77; April, 1940.

This article describes an experiment in elementary science in growing beans in the schoolroom. Excellent photographs taken at pertinent intervals shows the successive developmental stages in the growth of the bean.

—C.M.P.

WENTWORTH, EUNICE. "The Message of the Trees." *The Grade Teacher* 57: 30; April, 1940.

This is a cooperative class exercise suitable for arbor day in which children represent different trees.

—C.M.P.

ECHTERHOFF, LELA. "Eyes." *The Grade Teacher* 57: 44–45, 71; May, 1940.

This elementary science unit for the intermediate and grammar grades list: (1) aims, (2) approaches, (3) subject-matter, (4) things to do, and (5) sources of material.

—C.M.P.

RAHER, MARIE, AND WAGNER, EMMA. "The Flower Unit." *The Grade Teacher* 57: 34, 58–60; May, 1940.

This elementary science unit for the primary grades lists: (1) objectives, (2) procedure, (3)

point to develop, (4) cooperative stories, (5) seatwork, (6) vocabulary, and (7) references.

—C.M.P.

ANONYMOUS. "Ferns." *The Grade Teacher* 57: 17; May, 1940.

This is an elementary science unit adaptable to all grades.

—C.M.P.

ANONYMOUS. "The Great Northern Loon." *The Grade Teacher* 57: 16, 79; May, 1940.

This is an elementary science unit adaptable to all the grades.

—C.M.P.

VAN AMEYDE, MARRINUS. "An Excursion to an Automobile Plant." *The Instructor* 49: 80; May, 1940.

This science unit lists (1) classroom preparation, (2) objectives, (3) preliminary activities, (4) the trip itself, (5) resulting activities, (6) correlations, and (7) values of the trip.

—C.M.P.

LINDSJO, ELEANOR. "Our National Parks." *The Instructor* 49: 37–50; May, 1940.

Objectives, approaches, bibliography and activities are listed for each grade level: primary grades, middle grades, and upper grades. The primary grade unit is entitled: "A Visit to Yellowstone"; the intermediate grade, "Examples of Erosion and Volcanic Action," and the upper grade unit "Parks for a Nation's Pleasure."

—C.M.P.

UREY, RUTH T. "A Dairy Unit." *The Instructor* 49: 11, 77; May, 1940.

This unit lists concepts to be developed, outcomes desired, possible approaches, activities, and integrating activities with various school subjects.

—C.M.P.

STEVENS, MARION PAINE. "Milk—The Perfect Food." *The Instructor* 49: 47–56; September, 1940.

This illustrated unit presents facts, objectives, approaches, procedures, activities, experiments, and bibliography. The primary grades unit is entitled "The Story of a Bottle of Milk"; the middle grades unit "The World's Milk Supply," and the upper grades unit "The Importance of Milk in Modern Life."

—C.M.P.

LEWIS, INEZ JOHNSON. "Elementary Science." *The Grade Teacher* 58: 66–67, 95; October, 1940.

This is an outline of six units suitable for grade eight.

—C.M.P.

HILDRETH, RUTH C. "Our Water Supply." *The Grade Teacher* 58: 54–55, 79–80; October, 1940.

This is an illustrated unit intended for intermediate and grammar grades. Specific aims, approach, history of water supply, general information, correlations, and activities are included in the unit.

—C.M.P.

SECONDARY SCIENCE

TRYTTEN, M. H. "A Study of Secondary Physics." *American Journal of Physics* 8:54–56; February, 1940.

This article summarizes a study of 26 high schools in Cambria County, Pennsylvania. The method used was a questionary, and a follow-up interview. A few conclusions: (1) There is a tendency toward a course given one hour a day with no laboratory work; (2) The typical teacher is overloaded and inadequately supplied with equipment; (3) Some administrators rate physics on the basis of its nuisance value; (4) Physics is poorly taught, partly because the teacher is poorly prepared, and partly because he is overworked; (5) Weakened emphasis on mathematics has hurt physics.

Physics may be on the way out. "The present tendency to replace it by some pale, apologetic, Alice-in-Wonderland type of social science course or a general science 'survey course' offering material chosen for its ability to capture a supposedly vagrant interest is hardly likely to impress the physics teacher as a step forward."

—C.M.P.

WALLING, MORTON C. "Secrets in Stone Revealed by Your Microscope." *Popular Science Monthly* 136: 206–207, 246–247; February, 1940.

Preparing, mounting and the identification of different kinds of stones are described.

—C.M.P.

WAILES, RAYMOND B. "Table-Top Oil Refinery." *Popular Science Monthly* 136: 209–211, 245; February, 1940.

This is a description of an interesting laboratory set-up to demonstrate oil refinery.

—C.M.P.

WAILES, RAYMOND B. "Tricks With Fire." *Popular Science Monthly* 136: 201–203, 239; April, 1940.

Several interesting experiments are described in this illustrated article.

—C.M.P.

WALLING, MORTON C. "Hair Tells a Story Under Your Microscope." *Popular Science Monthly* 136: 198–200, 238; April, 1940.

This illustrated article tells how to prepare, mount, and identify various kinds of hair.

—C.M.P.

WALLING, MORTON C. "Studying Bacteria With Microscope." *Popular Science Monthly* 137: 192–193; September, 1940.

This is an illustrated article on studying bacteria with a microscope.

—C.M.P.

SCIENCE IN GENERAL EDUCATION

HORTON, RALPH E. "A Science Teacher's Creed." *The Teaching Biologist* 9: 71–72; January, 1940.

The author presents his science teaching creed in ten major aspects. All teachers should have similar functional needs. Briefly the author's creed is (1) Science study is to be looked upon primarily as one means for general education; (2) Science study makes certain specific contributions, (3) Science subjects, biology, chemistry and physics, should be treated as branches or divisions of science and not as distinct fields of study; (4) The study of science should be carried on as an inquiry or investigation; (5) Problems which have their origin in, and are identified with, the daily aspects of living should be set or proposed for each unit of work; (6) Experiences with objects and phenomena should be provided by the teacher; (7) Principles and generalizations should not be stated in advance of experiences or of the inquiry which are necessary for understanding; (8) After a principle or generalization has been developed, it is equally important that it be used; (9) Students should be trained to rely on their own observations and to base their beliefs upon facts; and (10) The social implications of science principles should be used both as motivation and as applications of each unit of study.

—C.M.P.

TAYLOR, L. W. (Chairman). "Physics Instruction for Purposes of General Education." *American Journal of Physics* 8: 49–54; February, 1940.

This is the report of the A. A. A. S. Committee on the Improvement of Science Instruction for the Purposes of General Education. The report is based on 194 returns from 500 questionnaires sent out to 500 institutions. Most of those returning the questionary believe that the regular introductory course in physics is unsatisfactory for the student who will not specialize in science. A majority feel that the solution is not in modifying the regular course nor in a physical science survey course. On the other hand there seems to be a great diversity of opinion as to exactly what should be done about the non-science student.

—C.M.P.

GIVLER, JOHN PAUL. "An Undeveloped Mine of Materials for Visual Education." *Educational Screen* 19: 53–55; February, 1940.

A biology professor at the University of North Carolina writes about how pictures from the excellently illustrated magazines and rotogravure sections of newspapers may be used to great advantage in teaching. Explicit details of mounting and filing are given, based on practical experience.

O. E. Underhill.

READ, C. W. W. "Safeguards Against Accidents in School Science Laboratories." *School Science Review* 21: 964–977; March, 1940.

Safety in the laboratory is an ever-present problem with science teachers—in England (as this article shows) as well as here. This is an unusually good article on hazards in science laboratories. Rules and suggestions are included. Materials and experiments requiring extra precautions are discussed.

—C.M.P.

SYMPOSIUM. "Science Teaching Under Evacuation Conditions." *School Science Review* 21: 1014–1018, 1155–1158; March and June, 1940.

This article describes science teaching in six different schools in evacuated areas in England. At the time the article was written the schools seemed to be doing only a fairly adequate job in science teaching.

—C.M.P.

GEER, WILLARD. "Physics Survey Courses Versus Physical Science Survey Courses as Agencies of General Education." *The American Physics Teacher* 7: 389–394; December, 1939.

This is the report of a study of physical science survey and physics survey courses in 865 institutions. The principal data was obtained from an intensive study of 35 physical science survey courses and 38 physics survey courses. These courses are compared as to status, impetus for establishment of these courses, aims and objectives, subject matter and its treatment, methods of teaching, and teacher preparation. The author points out many inconsistencies between the avowed purposes and the content of physical science survey courses.

—C.M.P.

ARNSPIGER, V. C. "Research in Instructional Sound Film Production." *The Advanced School Digest* 5: 10–12; December, 1939.

Dr. Arnspiger, Vice-President in Charge of Research and Production of Erpi Classroom Films, discusses general and specific problems that enter into a program of instructional film production.

—C.M.P.

SCIENCE

STUART, ARTHUR A. "Strange Creatures from the Ocean Jungles." *Popular Science Monthly* 136: 73–80; February, 1940.

This article describes strange inhabitants found near the ocean floor. Photographs in color add to the interest in the article.

—C.M.P.

HOGG, JOHN EDWIN. "How Good Is a Used Car?" *Popular Science Monthly* 136: 132–135; February, 1940.

The article presents simple tests for checking a used car's steering gear, motor, front wheel

assembly, clutch, brakes, drive assembly, transmission and bearings, tires, and so on.

—C.M.P.

ANONYMOUS. "Man Is Longest-Lived Mammal." *Science News Letter* 37:124; February 24, 1940.

Recent data indicates man is the longest-lived mammal, one authentic case being 114 years, and several over 100 years. Elephants live to be nearly 50, rhinoceros 40 years, hippopotamus 42 years, lion 25 years, tiger 19 years, cat 20 years, and turtles over 100 years.

—C.M.P.

MISER, HUGH D. "The Nation and Petroleum Geology Today." *Science* 91:249–252; March 15, 1940.

In 1938 the value of the petroleum output in the United States exceeded one-third of the value of all mineral production. Coal, natural gas and iron followed in that order. Domestic petroleum came from about 370,000 wells in 23 states, with only 5 per cent imported. More than 970,000 wells have been drilled, the deepest well being 15,004 feet in California. Known reserves reached the highest figure in history in 1939, estimates ranging from 14 to 17.5 billion barrels. Present known coal reserves could supply present oil and gas demands for about 2,000 years.

—C.M.P.

ANONYMOUS. "Snake Myths Smashed by Science." *Popular Science Monthly* 136:90–93; March, 1940.

This is a very interesting article on the numerous snake stories that are not so! Information was furnished by a well-known snake authority, Mr. C. B. Perkins of the San Diego Zoo.

—C.M.P.

WARDEN, CARL. "Be Your Own Weatherman." *Popular Science Monthly* 136:65–72; March, 1940.

This is an illustrated, practical article on forecasting weather. Several simple rules relating to forecasting are included. Illustrations are in color.

—C.M.P.

ANONYMOUS. "Dangerous Bleeding Stopped by New Thrombin Preparation." *Science News Letter* 37:179; March 23, 1940.

This new anti-bleeding substance is a preparation so powerful that when sprinkled on a wound it stops bleeding in one second. It is obtained from beef-blood in slaughter houses.

—C.M.P.

MARTIN, ROBERT E. "How Science Puts Color to Work." *Popular Science Monthly* 136:57–64; April, 1940.

This is an illustrated article depicting how science is putting color to work in industry, medicine, and business. A color chart testing personality traits is given.

—C.M.P.

REIMANN, IRVING G. "Footprints on the Sands of Time." *Hobbies* 20:68–69; April, 1940.

An exhibit of six dinosaur tracks, in relief, each thirty-four inches long and fifteen feet two inches apart has recently been placed in the Buffalo Museum of Science. These tracks are unlike any other dinosaur tracks ever discovered in America and the skeleton of their maker has never been found. He walked on three toes and must have towered thirty feet or more in height.

—C.M.P.

CUTLER, ELLIOTT C. "Harvey Cushing." *Science* 90:475–482; November 24, 1939.

One of the finest biographies the abstractor has happened across in some time. No other individual in modern medicine has revealed such a variety of accomplishments as Harvey Cushing: master-surgeon, neurologist, physician, critical investigator, artist, and inspiring teacher.

—C.M.P.

Book Reviews

DOWNING, ELLIOT R., AND MCATEE, VEVA M. *Living Things and You.* Chicago: Lyons and Carnahan, 1940. 673 p.

The senior author has been long an advocate of the desirability of developing scientific thinking in high-school-science courses. *Living Things and You* gives major emphasis to scientific thinking, problem seeing, and problem solving. Each unit has summarizing paragraphs on these three aspects. The authors attempt to give students a mastery of those principles that help solve the largest number of life's problems, and enough practice in solving these problems to apply the principles in solving other problems when the need arises. Each unit in the text deals with a principle or with a group of closely related principles.

The subject matter seems well selected and the literary style should appeal to biology students. The illustrations are pertinent. Each unit contains a preview, a series of problems, a summary review, self-test, and suggestions for scientific thinking.

The appendix includes a list of visual aids, a table of energy values and composition of foods, a classification chart of plants and animals, and a useful glossary.

Living Things and You would seem to be an excellent text with carefully selected subject matter, appealing illustrations, a most readable style, and in agreement with most modern practices in education. —C.M.P.

CARPENTER, HARRY A., BAILEY, GUY A., AND STROETZEL, BERNICE T. *Adventures in Science with Bob and Don; Adventures in Science with Jane and Paul.* Boston: Allyn and Bacon, 1940, 137 p. $0.54; 186 p.

These are the second and third books in this delightful Rainbow science series. The first book has previously been reviewed in *Science Education.* The books have been checked for reading and vocabulary difficulties. The science content is scientifically accurate and would seem to be appropriate for the grade level for which it is intended. There are nearly a hundred beautiful four-color pictures. The stories are interesting, continuous, child-appealing. The books may be used either as basal texts or as supplementary readers. This series should be included definitely among the present three or four best elementary science series and will be welcomed by elementary teachers. —C.M.P.

CURTIS, FRANCIS D., CALDWELL, OTIS W., AND SHERMAN, NINA HENRY. *Everyday Biology.* Boston: Ginn and Company, 1940. 698 p. $1.92.

Summer session science teachers in the reviewer's class rated *Everyday Biology* the best textbook in high-school biology then available. It was equally well-liked by the summer high-school students who used it as a basal text. Simplicity of vocabulary and simplicity and clarity of style, selection of interesting, comprehensible content, and photographs and illustrations that are pertinent, interpretive, and appealing were factors making the book a favorite both with teachers and pupils. The book is undoubtedly one of the finest high school texts yet written.

Each of the eight units presents a major phase of biology. Guidance in the selection of specific content was secured through extensive research by the authors and other investigators. Special care has been taken to achieve the major aims of science teaching. The material was used extensively in the biology classes before final publication. Vocabulary difficulties received especial attention.

At the beginning of each chapter is a list of questions answered in the content material that follows. Pupil self-tests are distributed at frequent and appropriate points and more extensive tests are provided in a separate manual.

There is provision for an abundance of laboratory work, additional exercises and activities, exercises on scientific method, pupil and class projects, and special reports.

Everyday Biology offers every evidence of being most teachable from the standpoint of the teacher and of being challenging to and well-liked by the pupils.

—C.M.P.

WATKINS, RALPH K., AND PERRY, WINIFRED. *Science in Our Modern World.* New York: The Macmillan Company, 1940.

Book 1. Grade 7. *Understanding Science,* 432 p.	$1.28
Book 2. Grade 8. *Science for Daily Use,* 500 p.	$1.48
Book 3. Grade 9. *Science for Human Control,* 588 p.	$1.68

Here is a set of books built on a sound foundation. It makes use of the cyclic treatment. It surveys the whole field of elementary science in integrated units. It attempts to develop the scientific method of thinking and at the same time covers the practical aspects of science that put questions into the mouths of junior high pupils. The material is treated in twelve units. Each unit has a preface called "What this Unit Is About," followed by a list of unit problems. At the end of each unit we find: "Things to Do," "Some Things to Remember" and a list of "Books to Read." Experiments, exercises and tests are not included in the text. There are excellent illustrations, both halftones and line cuts. The books deserve a place in the sun.

—W.G.W.

WATKINS, RALPH K., AND PERRY, WINIFRED. *Workbooks for Science in Our Modern World.* New York: The Macmillan Company, 1940.

1. *Workbook to Understanding Science,* 128 p. $0.68.
2. *Workbook to Science for Daily Use,* 140 p. $0.72
3. *Workbook to Science for Human Control,* 148 p. $0.76

We have here a complete set of forms with spaces for pupil answers to questions and records of his activities. The order of topics follows that in the texts and directions are given for activities in each of the problems of the various units. The sheets, while bound together, are detachable making it possible for the pupil to pass in a single or more sheets as completed, if desired. The manual requires a minimum of pupil time in making his record. It is of the time-saving type of which we approve. Each unit is introduced with "What Am I Expected to Learn?", followed by "What Do I Know About . . .?". The unit ends with lists for "Leisure Time Activities" and "Where Can I Find It?" They are high grade workbooks, up-to-the-minute in teaching technique. The last 22 to 26 pages of each book are devoted to tests; one for each unit.

—W.G.W.

POWERS, S. R., NEUNER, E. F., BRUNER, H. B., AND BRADLEY, J. H. *Exploring Our World.* Boston: Ginn and Company, 1940. 496 p. $1.28.

This is the first of a series of three books for the junior high school in a program of "Adventuring in Science." It comprises 16 chapters organized into the following six units: (1) "Science in Our Lives"; (2) "The World of Water"; (3) "The World of Air"; (4) "The World of Rock"; (5) "The World of Living Creatures"; (6) "The World of Action." Each unit is introduced with a double-page picture typifying the subject which follows and then follows a set of exploratory questions. Each chapter ends with: "Correct These Statements," "Questions for Discussion," and "Things to Do." Throughout the text will be found *Exercises,* suggesting experiments or activities for the student. A bibliography of "Readings in Science" and a pronouncing glossary of science words are at the end of the book. It is an unusually attractive volume with its modernistic illustrations. It is written in a style to interest the junior-high school pupil.

—W.G.W.

POWERS, SAMUEL RALPH, NEUNER, ELSIE FLINE, BRUNER, HERBERT BASCOM, AND BRADLEY, JOHN HODGDON. *Our World Changes.* Boston: Ginn and Company, 1940. 565 p. $1.52.

Our World Changes is the second of a three-book general science series entitled *Adventuring in Science.* This *Adventuring in Science* series presents a unified, coherent program centered around the general theme that "living things, including man, are dependent on each other and on their physical environment." This particular volume emphasizes certain physical aspects of the environment—stars, weather, climate, landscape and the forces which change it, and the use of food energy and healthful living. The final unit deals with conservation and shows how man can use and yet not abuse the natural wealth of the earth.

Each unit has a pupil preview intended to challenge his interest and arouse his curiosity. Interspersed with the reading matter are numerous pupil exercises—experiments, projects, special reports. At the end of each chapter is a list of partly or wholly false statements for correction, also questions for discussion and things to do. At the end of the text is a brief list of well selected pupil readings in science, and a key list of important science words with indicated pronunciation and definition.

The book is written in a style that will appeal to general science students. There are numerous illustrations and photographs. Many of the latter are full page, and the others have been placed either at the top of the page or at the bottom.

The content of the book has every evidence of having been most carefully selected both as to interest, grade difficulty, and in ability to challenge and stimulate the thinking of pupils.

—C.M.P.

CRAIG, GERALD S., BALDWIN, SARA E., HURLEY, BEATRICE DAVIS, CONDRY, MARGARET G., HILL, KATHERINE E., JOHNSON, GOLDIE M., AND LEWIS, JUNE E. *New Pathways in Science.* Boston: Ginn and Company, 1940.

The earlier Craig series, *Pathways in Science,* set a high standard for the many elementary science series that have followed.

This new series easily surpasses the earlier series. The content is definitely more teachable. There is better grade placement of content material, better organization and integration from grade to grade, and a more desirable emphasis upon social values and conservation. The books are more attractive and appealing, both inside and out. The six books emphasize such basic science principles as space, time, change, adaptation, interrelation, and variety. The vocabulary has been carefully checked for grade placement, and the illustrations are apt and appealing. Practical manuals are available to provide the teacher with explicit help.

The following books are intended for grades one to six respectively:

We Find Out	223 p. $0.72
Changes All Around Us	286 p. $0.80
Our Earth and Sky	292 p. $0.84
The Earth and Life Upon It	368 p. $0.90
From Sun to Earth	439 p. $0.96
The Earth Then and Now	480 p. $1.00

—C.M.P.

BEAUCHAMP, WILBUR L., MAYFIELD, JOHN C., and WEST, JOE W. *Everyday Problems in Science.* Chicago: Scott, Foresman and Company. 1940. 752 p. $1.72.

In size this might be taken for a college text. The cover design, however, places it properly in

the high school. It is a freshman course made up largely from material in the three books of the junior high series by the same authors. It caters to pupil interest and problems are well developed. The material is covered in 20 units. Each unit is organized on this plan: (1) An introduction called "Looking Ahead", (2) The textual material including experiments, (3) Self-testing exercises and problems to solve, (4) At the unit end are more questions under the heading "Looking Back", additional exercises and a list of book references. The illustrations are mostly fine halftones of large size; they make the book particularly attractive. The book is an outstanding contribution to our ever increasing list of freshman science texts.

—W.G.W.

HUDSPETH, JACK AND HUDSPETH, FRANCES H. *Elementary Science Book 2; Teacher's Manual for Elementary Science Book 2.* Austin: The Steck Company, 1940. 72 p., 22 p. $0.25; $0.35.

This elementary science workbook and teacher's manual is intended for the second grade. The other workbooks and teachers' manuals of this series have been previously reviewed in *Science Education.* Teachers using workbooks will find this one very useful. Other science teachers will find in the teacher's manual many suggestions that should increase the effectiveness of their teaching of elementary science.

—C.M.P.

BLOUGH, GLEN O., BRINK, IDA K. AND BLOUGH, HELEN DOLMAN. *Elementary Science for All Grades.* Dansville, N. Y.: F. A. Owen Publishing Company. 96 p. $0.25.

This interesting, practical Handbook has the following topics: (1) a point of view for science teaching; (2) enriching science teaching—all grades; (3) things to see the year around—grades 1 or 2; (4) experiencing science—grades 1 or 2; (5) activities of plants and animals—grades 3 or 4; (6) studying the heavens—grades 4 or 5; (7) the wonder of plant growth—grades 5 or 6; (8) animals that lived long ago—grades 5, 6, or 7; (9) some everyday science—grades 7 or 8; (10) science hobbies—all grades; and (11) bibliography.

—C.M.P.

HUEY, EDWARD G. *What Makes the Wheels Go Round.* New York: Reynal and Hitchcock, Inc., 1940. 168 p. $2.50.

The sub-title of this book is *A First-Time Physics,* and it seems to be just that. It has been contended that physics is the most difficult of all the sciences to popularize and so simplify its vocabulary that the layman can really comprehend the underlying principles. If this has been true of attempts to popularize physics, it has been doubtly difficult to simplify physics principles for the elementary school level. That is what Mr. Huey has attempted to do in this book. In the opinion of the reviewer, this is probably the most successful effort yet made. For that reason both the author and the publishers are to be congratulated for so timely and splendid a book. Arithmetic and experiments have been omitted as well as all unnecessary technical terms. Touching upon all the usual aspects of physics, this book is truly a splendid introduction to a rather difficult, complex science subject.

—C.M.P.

KNOX, WARREN, STONE, GEORGE, MEISTER, MORRIS, AND NOBLE, DORIS. *The Wonderworld of Science Book One, Book Two, and Book Three.* New York: Charles Scribner's Sons, 1940. 128 p., 160 p. and 192 p. $0.72; $0.80; $0.88.

The Wonderworld of Science comprises a series of three books intended for the primary grades. Particular attention has been paid to reading difficulties and scientific accuracy. Child language and simplicity of vocabulary dominate the style of the reading material. Classroom teachers and reading experts carefully checked the textual material and the vocabulary was checked against the Thorndike, the Gates, and the Stone list. The illustrations are apt and appealing.

The authors are well-known science teachers, and although all are not primarily elementary science teachers, the material has been used experimentally by individuals who do teach elementary science. Surely this series should be included among the three or four recognized leaders of elementary science readers and will be welcomed by all elementary science teachers.

—C.M.P.

MCKAY, HERBERT. *In Search of Science.* New York: Oxford University Press, 1938. In all 156 pp. $0.80 each.

Book I *Air, Wind and Rain.*
Book II. *Looking-Glasses and Candles.*
Book III. *Noises. The Sun and the Moon.*

These are paper-covered English books, "Simple Science in Simple English." They discuss everyday phenomena of science, telling things to do, calling attention to the science of our environment, and also suggesting things to talk about. They are written to interest pupils of third school year particularly, being based on a standard vocabulary of 1500 words already familiar to third-year pupils in English schools. Many illustrations are provided.

—L. M. Shoemaker.

WPA PENNSYLVANIA WRITER'S PROJECT. *Dream of Stars.* Chicago: Albert Whitman and Company, 1940. 48 p. $0.50.

This is the seventh in a series of thirty elementary science books intended for the third

and fourth grade. The book has been checked carefully for scientific accuracy and vocabulary difficulties. As indicated by the title, *Dream of Stars* gives a simple explanation of what the stars and planets are, why they shine, how they move, how far away they are, and how big they are.

—C.M.P.

LONG, ERNESTINE M. J. *Project Kit.* St. Louis, Missouri: Normandy High School, 1939. 40 p. $0.35. *Project Kit Two,* 1940. 59 p. $0.35.

The project kit, which is loose leaf and will be added to from time to time, contains articles which were written by students for students with the help of their teachers and sponsors of science chapters in the Missouri Junior Academy of Science. However, the kit includes the work of students from Florida, New York, and Illinois. The kit is not for profit but it is hoped that "costs" will be made out of it. Sponsors of Junior Academies in other states will welcome these bulletins to assist them in Junior activities in their own science clubs or chapters. The Junior Academy movement is still very much alive as shown by the lively and timely activities found in the kit.

To illustrate how versatile these are, a partial list of the contents is given here: "Operations of a Junior Weather Bureau," "Relief Model of Missouri," "Electrical Star Map," "Chemical Trees," "Metal Coloring of Copper, Brass, and Bronze," "The Oudin Coil," "Cold Light," "Some Common Rocks and Minerals."

Project Kit Two is a continuation of *Kit One.* Included in this one are article from Juniors of Texas, Kansas, and Virginia.

—Greta Oppe.

BURDICK, A. J., and HUDDLESTON, J. J. *General Science—Directed Development by Demonstrations and Exercises.* New York: Oxford Book Company, 1938. 215 p. $0.54.

This is a workbook and laboratory manual in general science for ninth-grade students. The contents follow closely the New York State Syllabus as well as the syllabi of other leading school systems.

All the leading textbooks have been thoroughly referenced, therefore the workbook can be used with any text. Important words and expressions are emphasized in the review exercises. Each topic includes a "Contribution page" permitting the pupil to include in his record material that he has created or collected. There are excellent diagrams for labelling and studying. The book abounds in motivating materials. Teachers of general science will welcome this workbook for the simple way in which science facts are used to interpret everyday phenomena. The book well deserves its sub-title, "Directed Development."

—Greta Oppe.

PLATT, J. C., JONES, FREDA, FRID, W. C., HOPKINSON, J. H. *General Science.* New York: The Chemical Publishing Company of New York, Inc., 1938. 167 pp. $1.50.

This is an English book, the first part of a two-volume course which attempts to present the material of general science logically as one connected whole, in an effort to bring out the intimate connection between science and life. Biology is given as the core of the course; physics and chemistry are introduced to explain biological facts. A study of the flower, seeds, properties of water, a study of air, combustion, the cabbage white butterfly, the house fly, the aquarium are some of the chapter titles. Experiments to be performed by the student with simple apparatus are given. The book is illustrated with drawings. While having much of value and interesting from a comparative standpoint and for supplemental use, the book would not be suitable for individual use by American pupils.

—L. M. Shoemaker.

SMITH, ELLA T. *Exploring Biology.* New York: Harcourt, Brace and Company, 1939. $1.84.

This is a well organized high school text. It aims to "help the pupil master a few big principles of biology instead of the facts of botany and zoology." It contains many teaching devices, such as opening each new area with a dramatic episode in the history of biology, an abundance of suggested activities, a cumulative dictionary and exploratory questions.

—O. E. Underhill.

BAISCH, CARL W., and GLADIEUX, ROLAND J. *Directed Activities in Chmistry; Objective Tests in Chemistry.* New York: Oxford Book Company, 1939. 306 p. $0.69.

New books by these nationally known educational book publishers always seem to attract attention. This new workbook and laboratory manual designed for use with any textbook conforms to the latest requirements of the College Entrance Examination Board. The subject matter is divided into fourteen units conforming to the fundamentals regarded as basic in a good chemistry program. The topics of each unit are page-referenced for most of the leading chemistry textbooks. *Survey Questions* which introduce each unit focus attention upon important problems to be solved. *Related Activities* list interesting things to do and interesting things to read. A nice departure from the usual method of giving references is the listing of the books in one column and in a second column a listing of the topics to be found in these books pertaining to the unit where these topics are discussed. Experiments are so constructed that they may be performed in a single period if necessary, and the *Related Questions* following

the experiments provide drill on desirable facts and principles. *Comprehensive Summary Tests* are provided with the manual.

The Objective Tests manual (free with *Directed Activities*) contains a series of 28 tests. Included also is a first semester test and a second semester test.

—Greta Oppe.

BROOKS, WILLIAM O., and WEINER, EARL M. *Directed Activities in Physics.* New York: Oxford Book Company. 272 p. $0.69.

This workbook and laboratory manual is organized on a unit plan with sixty-eight experiments, a sufficient number to permit selection of those which best meet the needs of a class. Each experiment is preceded by an introduction designed to stimulate interest and also to furnish certain information to help the student in his work. *Data Tables* facilitate a clear and accurate recording of facts. Each unit is introduced by a group of survey questions. These with the previews attempt to motivate the subject matter and relate it to everyday activities and interests. An outline of material for textbook study and a glossary of scientific terms help the student to check his mastery of subject matter. A large number of diagrams accompany the experiments, and a noteworthy feature is the inclusion of questions on these diagrams in the testing material. Summary tests, largely objective, are provided with each unit. These tests are graded to encourage the poorer student and to challenge the better student in his progress. A mid-year and a final examination are included among the tests. The contributions of great physicists are conveniently arranged in tabular form in the form of a completion exercise. The reviewer would prefer this to be listed in the body of the workbook rather than in the Appendix, since appreciation is one of the desirable attitudes of any program in physics.

—Greta Oppe.

SAUER, CARL. *Man in Nature, a First Book in Geography.* New York: Charles Scribner's Sons, 1939. 273 p. $1.20.

Here is a fascinating and interesting geography of America before the days of the white men, told in textual material with delightful illustrations by Antonio Sotomayor. The choice of the Indian as the human element in the book was based on these facts: The diversity of Indian life in North America is so great that it includes the whole series of culture stages besides providing excellent illustration of man's increasing mastery over nature. The study of the land as it was in nature provides simple lessons in physical geography as well as conservation of natural resources.

Even a grown-up will find this book stimulating, for geographies of earlier generations which emphasized place learning emphasized a necessary background of fact about the world whereas modern geography has become a social science placing these facts in meaningful relations.

The order of units gives a continuous swing across the continent of North America beginning with the simplest forms of Indian living, which are found in the far West; hence the start in California and Nevada and the end in Mexico and the Southwest. The animal and plant life pictured for each regional area will interest the reader in the natural beauty of our land encouraging further study in elementary science. There are fourteen units, nine maps, some interesting things to do, and a well-selected list of books about Indians who lived in the areas described, including a list especially for the guidance of the teacher.

In the preface which is a "letter to all boys and girls," the author states that the book was written so that it will be "good to read and beautiful to look at." The book is that and author and publisher are to be congratulated.

—Greta Oppe.

TRANSEAU, E. N., SAMPSON, H. C., and TIFFANY, L. H. *Textbook of Botany.* New York: Harper and Brothers Publishers, 1940. 812 p. $4.00.

When the science materials offered in the secondary schools about a generation ago were extended and synthesized into courses called general science and general biology, college specialists in science viewed the new courses with some misgivings. Certainly these courses could not be propaedeutic to college science. The tendency to integrate science for the layman and to make his interrelationships with the phenomena about him clear and practical continued. It spread to the colleges in the form of integrated, survey, or orientation courses. Although the books written for such courses were accused of many errors of science, their general acceptance, rapid growth, and popular appeal have given the authors of books in the special fields of botany, zoology, chemistry and physics reason to consider modifying their purposes and organization of their publications.

The authors of *Textbook of Botany*, cognizant of the trend in science for the general education of the non-specializing student, have modified the "traditional" aproach to botany. After overviewing the field of botany and suggesting taxonomic procedures, they give attention to the seasonal aspects of plant life and local plant communities. The cell as the unit of structure and function does not appear until page 59 and then is given less than ten pages. It is clear that the intention is to start with familiar things in their total relationships. Later materials are less familiar, but the emphasis has been shifted from that of earlier texts to one involving physiological processes and ecological relationships and controls. The organization is a step forward towards functional education at the college level.

The book is definitely up to date in that recently established materials are an integral part of discussions. When accompanied by suitable laboratory and field experiences it should provide adequate training and information for a basic course in plant science.

—M. L. Robertson.

MORTON, H. *Science for Handcraft Students.* New York: Chemical Publishing Company, Inc., 1940. 149 p. $3.00.

Here is a texbook for handcraft students of all types interested in the scientific principles underlying wood and metal work. In the past a craftsman simply used his tools; today he is expected to know something of the scientific principles involved in workshop practice. The principles of mechanics, hydrostatics, chemistry and electricity as well as fundamental measurements and tools for measuring all find expression here. This English book is based on the syllabus in Elementary Science (section I) for the First Handcraft Teachers' Examination of the City and Guilds of London Institute, but its scope is not limited to the examination. Any book that can correlate workshop practice and science is a welcome asset in workshop practice. This one includes experiments, especially the kind that can be performed with improvised apparatus or that constructed by the student. The book is an asset to all those who are working in trades classes or to those who do not have time to take a regular course in physics.

—Greta Oppe.

GRUENER, HIPPOLYTE and LANKELMA, HERMAN P. *Introduction to Organic Chemistry.* New York: American Book Company, 1939. 533 p. $3.00.

Outstanding in its originality as to the order of presentation of subject matter and the effective simplicity of expression it should prove a fine text for a general organic course for the student whose interest is not primarily chemistry but a field in which chemistry is a strong supporting subject. The interrelations of the various divisions of organic chemistry and also the similarity in relation of behaviors in inorganic chemistry with those in organic chemistry is presented so skillfully as to simplify the study and hold the interest. To the latter end also are included a number of applications of organic chemistry to the industries as well as to related fields of study and the recent trends in this line.

—Ruth Gerber.

HEATON, KENNETH L., AND WEEDON, VIVIAN. *The Failing Student.* Chicago: The University of Chicago Press, 1939. 286 p. $2.50.

This is the resumé of academic failure and the implications for education. It is based on a service study sponsored by Albion, Central State Teacher's College, Michigan State, and Olivet Colleges in Michigan. It is an intimate and frank report of what was found from a study of 938 students on probation. These students supplied the necessary data on their study habits, their problems of finance, health, personal and social life. They were also given a series of examinations covering essential abilities and knowledge.

All college teachers as well as most high school teachers will find in this report information that will be both enlightening and helpful in their classroom teaching. The book will serve excellently for more intelligent freshman orientation and guidance, for better articulation of high school and college, for wiser curriculum adjustment, and for analyzing problems of teaching personnel related to student success and failure.

—C.M.P.

JESSUP, WALTER A., President. *The Thirty-third Annual Report of the Carnegie Foundation for the Advancement of Teaching.* New York, 1938. 239 p.

More than a million and a quarter students are enrolled in over 1,700 American colleges. Only about one-third received degrees at the end of the four years in the college in which they started. One-third drop out at the end of the freshman year, another third during the next two years. "The day may come when more colleges will perceive that the best job they can do is so much better than is now being done that they will no longer encourage this trek through the campus of hordes of credit hunters. . . ." "The methods of mass education, the academic lock-step, the spoon-feeding, the elaborate machinery of courses and credits, exercises and petty tests is a nuisance and a hindrance to those who are genuinely interested in their work." The latter quotation is from President Aydelotte but used with approval. The above gives some idea of President Jessup's introductory article on "Our Itinerant Students." Other articles of general interest are on Misplacement in College, Origin of Training in the Learned Professions and on Early Graduate Education. Most of the report deals with the statistics of retiring allowances.

—E.R.D.

BAILEY, TRUMAN. *Polynesian Venture.* New York: Doubleday, Doran and Company, 1939. 233 p. $3.00.

The author, artist, designer, nationally-known photographer, explored the Far East in search of native crafts which might be adapted to modern merchandising. Visiting Samoa, the Malay States, Japan, China, Korea, Cambodia, New Zealand, the Hawaiian and Philippine Islands, and the Polynesian Basin, Mr. Bailey through pictures and photographs, brings to the reader his many interesting adventures in these far away

places. Altogether the book is a most interesting travelog. The book is colorful, sympathetic, filled with human interest. The delightful style of the author makes this a most readable, enjoyable book.

—C.M.P.

HAUSRATH, JR., ALFRED H., AND HARMS, JOHN H. *Teacher's Manual to Accompany Consumer Science.* New York: The Macmillan Company, 1939. 125 p. $0.60.

This Teacher's Manual will prove an excellent teaching aid to those using the author's text (previously reviewed in *Science Education*). Objectives are stated for the whole course as well as specific objectives for each unit. There are preliminary problems, application problems, and suggested experiments and demonstrations.

—C.M.P.

KING, ELEANOR AND PESSELS, WELLMER. *Insect People.* New York: Harper and Brothers, 1937. 63 p. $1.25.

This is a very readable little book giving the life histories of outstanding insects such as praying mantis, bee, "tumblebugs", ants, wasps, grasshoppers and their kin, Japanese beetle. It also includes material on spiders. The reading is illustrated with many beautiful full-page photographs, which enhance the value of the book. The style of the book is stimulating and would tend to send the pupil out to study insects in the field. The book is good for supplementary reading from the fifth grade up.

—L. M. Shoemaker.

BYERS, EMMA F. *Out of Doors With Birds.* New York: The Womans Press. 84 p. $1.00.

This is "my own story of the birds—the story of years of enjoyment of our song birds. . . . These pages are written in the hope that they may be an aid to those who are interested in the popular study of our song birds." For anyone who would like to know how to begin bird study and "get into the spirit" of it, we recommend this book highly. It gives practical details of the identification of many of the birds of eastern North America, illustrated with the wealth of personal experience of the author. This book is especially to be recommended for city dwellers. Both teacher, layman and student will find it inspiring.

—L. M. Shoemaker.

SHOOSMITH, F. H. *Life in the Animal World.* New York: Robert M. McBride & Company, 1938. 278 p. $2.50.

This volume provides interesting reading on the animal kingdom to layman, teacher and student. Non-academic in its approach to the subject, but very complete in the range of animal illustrations, it gives one a wide picture of animal life, its breathing processes, locomotion, size and form, defence and offence, colour and camouflage, courtship, care of the young, behavior, racial history, animals and man. It is well illustrated by drawings and good photographs. The book draws on the lives of animals everywhere.

—L. M. Shoemaker.

SCHMID, BASTIAN. *Interviewing Animals.* Boston: Houghton Mifflin Company, 1937. 223 p. $3.00.

The German original of this book *Begegnung mit Tieren* was published in Munich in 1935 and the first English translation was published in 1936. The book records Bastian Schmid's personal acquaintance with many animals through which he tries to portray to us the nature of the animal. From the first chapter in which he tells how he came to study animals, picturing for us animals, domestic and wild, of his farm home, we feel the sympathy and understanding which he has for all forms of animal life. In the second chapter the minute description of how chickens come into the world provides an unusual amount of information for the teacher who carries through a breeding project with the domestic hen in her classroom. As an animal psychologist in charge of a "biological station" of both domestic and wild animals, Mr. Schmid's reports on the behavior and the psychology of these animals will be enjoyed by the animal lover everywhere.

—L. M. Shoemaker.

CURTIS, BRIAN. *The Life Story of the Fish.* New York: D. Appleton-Century Company, 1938. 260 p. $3.00.

This is an entertaining, yet scientific life story of the fish. In separate chapters are discussed the place of the fish in the animal kingdom, its body covering, framework, senses and nervous system, air-bladder, internal workings, reproduction and growth. The remaining chapters take up trout and salmon, other game-fish, habits and adaptations. The book is an excellent reference for the elementary, high school and college teacher, for high school and college students. The type of material given will serve to supplement and enliven instruction. The layman will likewise find the book interesting. Mr. Curtis is on the research staff of the State of California Division of Fish and Game and has presented data on the fish which is difficult to find assembled elsewhere. The introduction is by William Beebe. The book is illustrated with drawings.

—L. M. Shoemaker.

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